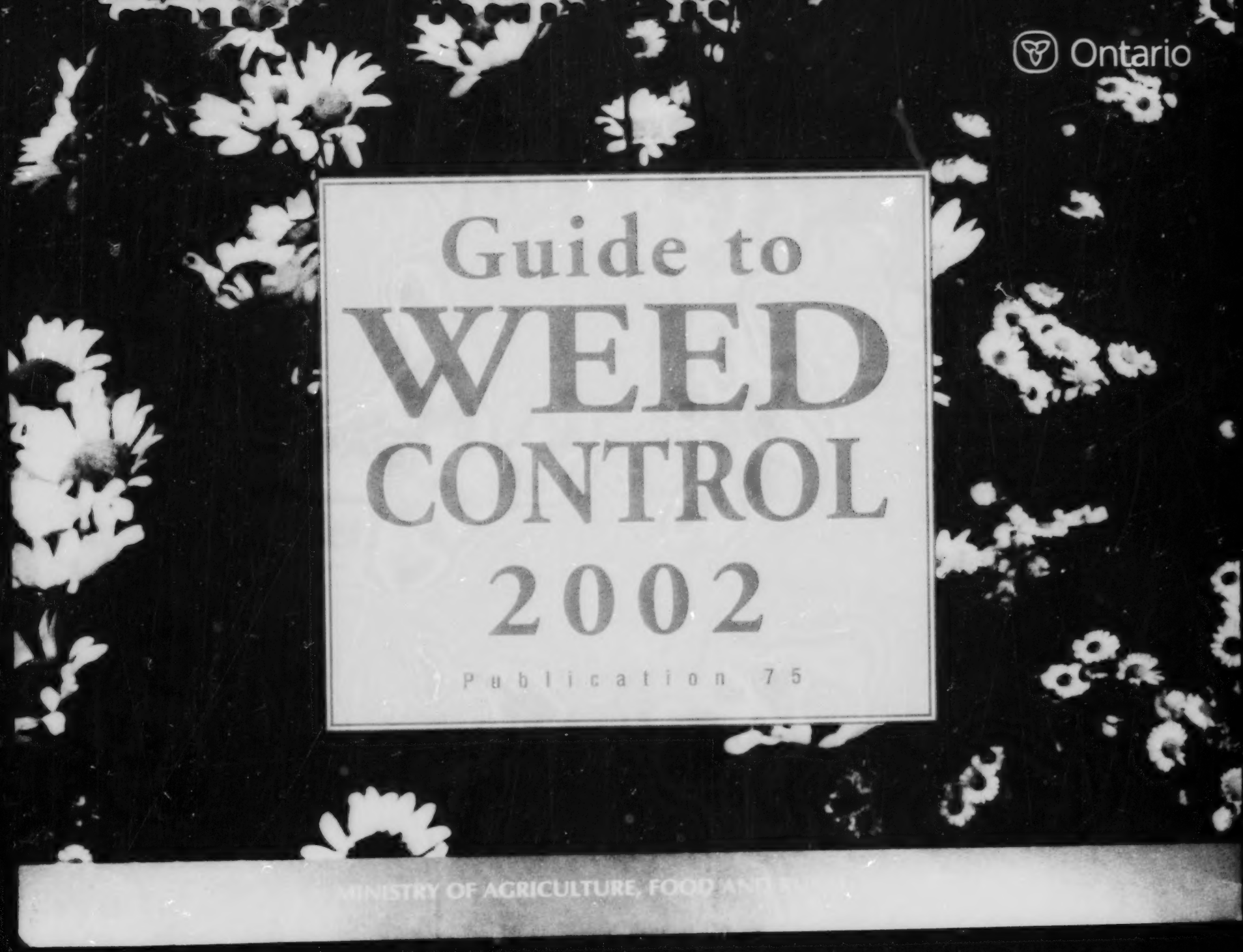
Ontario
Guide to
WEED
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2002
Publication 75
MINISTRY OF AGRICULTURE, FOOD AND

Discard old editions of this publication. Each year the Ontario Weeds Sub-committee of the Ontario Pest Management Research and Services Committee reviews the pesticides listed in this publication. To the best knowledge of the committee, at the time of printing, all of these pesticides were:

- federally registered
- reviewed by the Ontario Pesticides Advisory Committee (OPAC)
- classified by the Ministry of the Environment as of November 2001.

The information in this publication is general information only. By printing this publication, the Ministry of Agriculture, Food and Rural Affairs does not offer any warranty or guarantee, nor does it assume any liability for any crop loss, animal loss, health, safety or environmental hazard caused by the use of a pesticide mentioned in this publication.

The pesticide product label is a legal document. It is against the law to use the product in any other way. You must also use all pesticides in accordance with the *Pesticides Act* and Regulation 914, administered by the Ontario Ministry of the Environment.

This publication lists a number of brand names of pesticides. This is for your convenience only. It is neither an endorsement of the product nor a suggestion that similar products are ineffective.

Consult each product label for specific information such as compatibility with other materials and the effect of environmental conditions. Weather and other factors influence the effectiveness of pesticides and the likelihood of crop injury.

Health Canada has established maximum residue limits (MRLs) for pesticides. Processors or retailers may demand more restrictive limits. Growers should seek advice of their intended market as to which restrictions or limitations apply. Keep accurate and up-to-date records on pesticide use in each crop.

Federal Registration of Pesticide Products

The Pest Management Regulatory Agency (PMRA) of Health Canada grants registration following an evaluation of scientific data to ensure that the product has merit and value; and the human health and environmental risks associated with its proposed use are acceptable.

1. Full Registration

Pesticide registrations are normally granted for a period of five years, subject to renewal.

2. Temporary Registration

Temporary registration may be granted for a period not to exceed one year, where the registrant agrees to produce additional scientific or technical information, or the pesticide is used for emergency control of a serious pest outbreak.

Supplemental Labels

You MUST obtain a supplemental label and follow all the label directions when PMRA approves new uses for a registered pesticide that do not appear on the current label.

Examples of when you must use a supplemental label include:

- **Temporary Registrations for Emergency Use**
- **Minor Use Label Expansion** (new label statements for crops that do not already appear on that product label)

You can obtain a copy of a supplemental label from the pesticide manufacturer or pesticide vendor, the grower association that sponsored the emergency registration or minor use, from OMAFRA or PMRA's Pest Management Information Service.

For more information on the federal registration status check the PMRA web site at *www.hc-sc.gc.ca/pmra-arla* or call **1-800-267-6315.**

Regulation of Pesticides in Ontario

Classification of Pesticides into "Schedules"

The Ministry of the Environment classifies all pesticide products into one of six schedules, based on the potential hazards that product may have for human health and the environment. For up-to-date information on the regulatory status of any pesticide check the Ontario Pesticides Advisory Committee Web site at *www.opac.gov.on.ca* or call (416) 314-9230/Fax (416) 314-9237.

Licensing and Certification Requirements for Pesticide Users

You must be a certified grower or licensed exterminator to buy and use Schedule 1, 2 and 5 pesticides.

Requirements for Growers and Their Assistants

Growers must be certified through the **Grower Pesticide Safety Course** to buy and use Schedules 1, 2 or 5 pesticides on land they farm. There must be at least one certified grower for each farm operation.

All agricultural assistants must also receive formal pesticide safety training, recognized by the Ministry of the Environment, before they can use Schedule 2 or 5 pesticides under the supervision of a certified grower. This applies to all assistants — including family members, farm employees and seasonal workers.

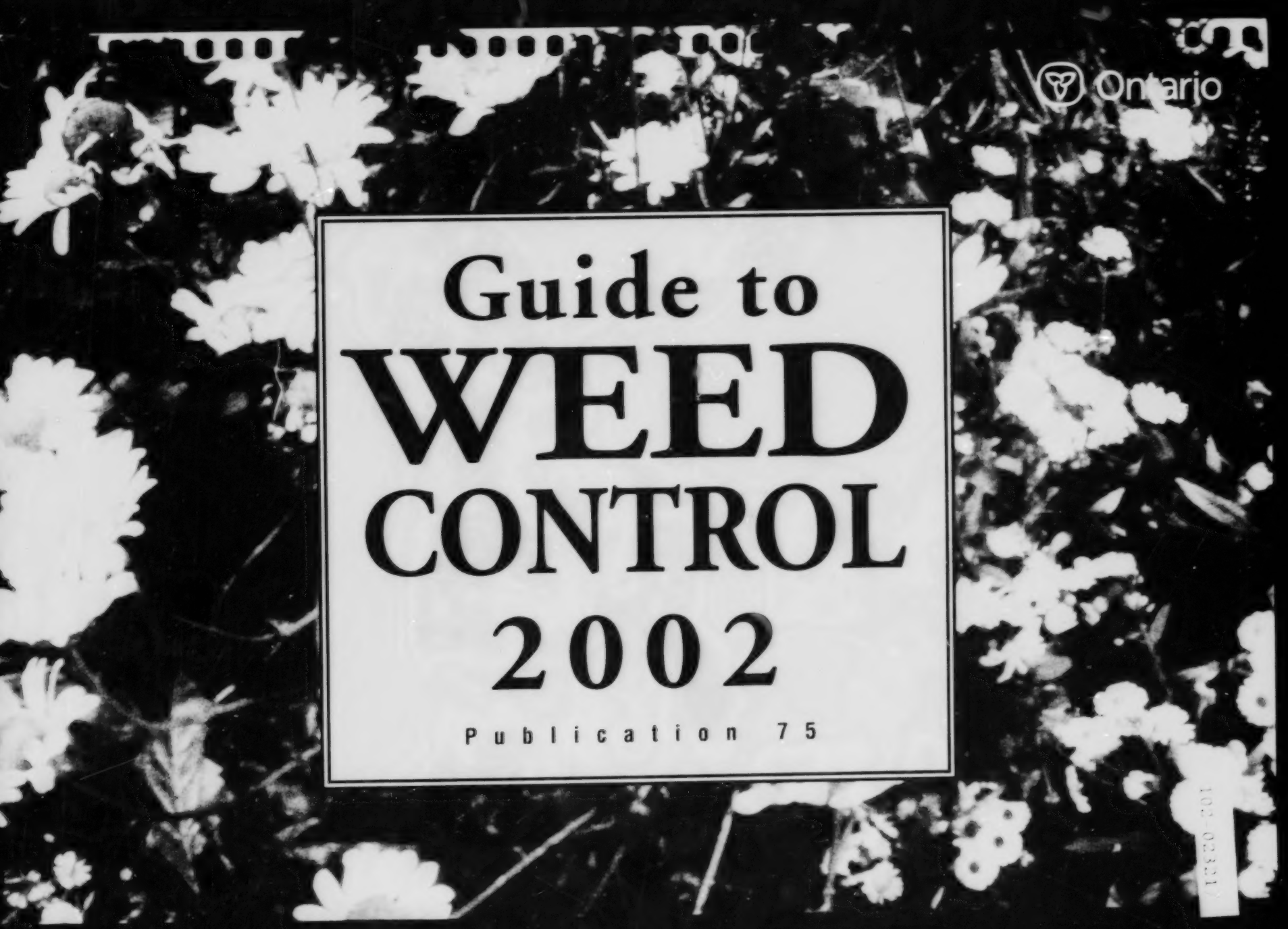
For more information about training for growers and agricultural assistants check the Ontario Pesticide Education Program Web site at *www.ridgetownc.uoguelph.ca/opep/* or call **1-800-652-8573.**

Requirements for Commercial Applicators and Their Assistants

If you plan to apply pesticides as a business, you must be a licensed exterminator. **This includes farmers who custom apply pesticides for other farmers and charge a fee for this service**. You must complete a home study course and certification exams, and send proof of certification to the Ministry of Environment to obtain your license.

Unlicensed assistants must be **Technicians** before they may handle Schedule 2 (with restrictions), 3, 4 and 6 products under indirect supervision of a licensed exterminator. Technicians may not handle Schedule 1 and 5 products. For more information about exterminators and technicians check the Ontario Pesticide Training & Certification Web site at *www.ridgetownc.uoguelph.ca/optc* or call **1-888-620-9999.**

Cette publication est aussi disponible en français.



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A complete listing of all OMAFRA products and services, as well as order forms, are available on the Web site. Orders can be faxed to the Government Information Centre at (519) 826-3633.

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CHAPTER 1. PRINCIPLES OF INTEGRATED WEED MANAGEMENT

Integrated Weed Management (IWM) uses all available weed control strategies in the best possible way to manage weed populations. Such strategies include cultural, mechanical and chemical methods of weed control. All these practices are components of an IWM system and none of these control measures on their own can be expected to provide acceptable levels of weed control. Therefore, instead of relying on only one particular method of weed control, an IWM system uses a combination of methods to control weeds. By following the principles of an IWM system we can reduce the use of herbicides and at the same time provide optimum economic returns to the grower.

Cultural Methods of Weed Control

Crop rotation

Crop rotation involves alternating different crops in a systematic sequence on the same land. It is an important strategy for developing a sound long-term weed control program. Weeds tend to thrive with crops of similar growth requirements as their own and cultural practices designed to contribute to the crop may also benefit the growth and development of weeds. Monoculture, that is growing the same crop in the same field year after year, results in a build-up of weed species that are adapted to the growing conditions of the crop. When diverse crops are used in a rotation, weed germination and growth cycles are disrupted by variations in cultural practices associated with each crop (tillage, planting dates, crop competition, etc.).

Field scouting

Field scouting is a key component of an IWM system. It involves the systematic collection of weed and crop data from the field (weed distribution, growth stage, population, crop stage, etc). The information is used, in the short term, to make immediate weed management decisions to reduce or avoid economic crop loss. In the long term, field scouting is important in evaluating the success or failure of weed management programs and for making sound decisions in the future.

Cover crops

The inclusion of cover crops such as rye, red clover, buckwheat and oilseed radish or overwintering crops like winter wheat or forages in the cropping system can suppress weed growth. Fast growing crops or crops exhibiting allelopathic properties can also suppress weeds. Highly competitive crops may be grown as short duration "smother" crops within the rotation. Additionally, cover crop residues on the soil surface will suppress weeds by shading and cooling the soil. When choosing a cover crop, consideration should always be given to how the cover crop will affect the succeeding crop.

Intercropping

Intercropping involves growing a smother crop between rows of the main crop. Intercrops are able to suppress weeds. However, the use of intercropping as a strategy for weed control should be approached carefully. The intercrops can greatly reduce the yields of the main crop if competition for water or nutrients occurs.

Nitrogen fertility

Nitrogen fertilizer can affect the competition between crops and weeds and in the subsequent crops. For example, nitrate is known to promote seed germination and seed production in some weed species. Nitrogen fertilization may result in increased weed growth instead of increased crop yield. Selective placement of nitrogen in a band can favour the crop over the weed. Use of legume residues as opposed to chemical nitrogen fertilizer to supplement nitrogen needs of the crop can enhance weed suppression. Legume residues release nitrogen slowly with less stimulation of unwanted weed growth.

Planting patterns

Crop population, spatial arrangement and the choice of cultivar (variety) can affect weed growth. For example, studies have shown that narrow row widths and a higher seeding density will reduce the biomass of later-emerging weeds by reducing the amount of light available for weeds located below the crop canopy. Similarly, fast growing cultivars can have a competitive edge over the weeds.

Tillage system

Tillage systems alter the soil seedbank dynamics and depth of burial of weed seeds. Studies have found that almost 75% of the weed seedbank was concentrated in the upper 5 cm of soil in no-till fields. In the moldboard plow system however, the seedbank is more uniformly distributed over depth. Other conservation tillage systems are intermediate to these two systems.

Weed seedling emergence is often more uniform from shallowly buried weed seeds and may result in better weed control. Weed seeds closer to the soil surface are more likely to be eaten or damaged by insects, animals, other predators and disease causing organisms.

Critical Period of Weed Control

The critical period of weed control is an important concept in IWM systems. This period has been defined as an interval in the life cycle of the crop when it must be kept weed-free to prevent yield loss.

This concept helps in determining the most effective time for non-residual postemergent herbicide applications, and reduces the practice of season-long residual herbicides, and unnecessary late applications of herbi-

cides. The critical periods are defined relative to a crop growth stage to account for soil, weather and seasonal variations. The critical period is based on a yield loss of less than 5% due to weed interference. In other words, the crop has to be weed-free during these stages to prevent a yield loss of more than 5%.

If weeds have been controlled throughout the critical period, the weeds that emerge later will not affect yield and can be controlled prior to harvest with a harvest aid to burn down the weeds and desiccate the crop.

TABLE A Critical Periods for Weed Control in Field Crops

Crop	Critical Period for Weed Control
Corn	3rd to 8th leaf
Soybeans	1st to 3rd trifoliate
White Beans	2nd trifoliate to 1st flower

The critical period can vary depending on weather and growing conditions. Some research with corn and soybeans has indicated that the critical period may vary with soil type and tillage system and where the end of the critical period may be extended slightly later on clay soils or when using no-till tillage systems.

Corn — The critical period extends from 3–8-leaf stage (4–10-leaf tip showing in the whorl, or V2–V6). Excellent weed control must be maintained throughout this critical period. Corn kept weed-free for approximately 34 days after planting (DAP) or until 6–8-leaf stage (8–10-leaf tips) had a yield loss of 0–5% under conditions of heavy weed pressure.

Soybeans — The critical period extends from the 1st to the 3rd trifoliate stage of soybean growth (V2–V3). Soybeans kept weed-free for approximately 15 days after crop emergence had a yield loss of 0–5%.

White beans — The critical period extends from the 2nd trifoliate to the 1st flower (V3–R1) stage of whitebean (approximately 45 days after planting).

Horticultural crops are very sensitive to weed competition, and need to be kept weed free from planting, emergence or budbreak, until the end of their **Critical Weed-free Period**. This differs slightly from the Critical Period for Weed Control, but is useful for crops where soil applied preemergent herbicides or cultivation are the main option for controlling weeds. If the crop is kept weed free for the **Critical Weed-free Period,** generally no yield reduction should result. Again, weeds emerging after the critical weed-free period will not affect yield, but control efforts after this time may make harvest more efficient, or reduce weed problems in subsequent years in perennial crops.

TABLE B Critical Weed-free Period for Horticultural Crops

Crop	Critical Weed-free Period
Apples, new plantings	During May and June
Apples, bearing	Budbreak until 30 days after bloom
Beets	First 2–4 weeks after emergence
Cabbage, early	First 3 weeks after planting
Carrots	First 3–6 weeks after emergence
Cucumbers, pickling	First 4 weeks after seeding
Lettuce	First 3 weeks after planting
Onions	First the whole season
Potatoes	First 4 weeks after planting
Squash	Early plantings compete better
Strawberries, new	During May and June
Tomatoes, fresh	First 36 days after transplanting
Tomatoes, seeded	First 9 weeks after seedling

Season-long weed control is not necessary

Alternative methods of weed control are available for all tillage systems. Studies have shown that banding herbicides will increase profitability. For example, selective application of herbicides in 30 cm bands on 76 cm wide corn rows represented an approximate 60% reduction in total herbicide applied into the environment. When complemented with inter-row cultivation, weed control and crop yields were maintained with lower herbicide costs.

Economic thresholds

Weed economic thresholds help in determining if weed density and interference is sufficient to justify control measures, i.e., if the yield loss avoided is greater than the cost of weed control. The time at which weeds emerge relative to the crop is a major determinant of yield loss. Early weeds that emerge at the same time as the crop cause more yield loss than weeds emerging after the crop is established. For example, economic threshold studies conducted with redroot pigweed, ragweed and barnyardgrass have found that the time of weed emergence in relation to the crop stage is more important than weed density when evaluating weed control options. Crop yield loss depends on the relative time of weed seedling emergence.

Corn — Corn tolerated a weed density of 4 plants/m of row when redroot pigweed emerged at the 6th leaf stage of corn, but only 0.5 plants/m when they emerged at the 3rd leaf stage of corn.

Soybean — Soybeans tolerated a weed density of 4–8 plants/m when redroot pigweed emerged at the unifoliate stage of the crop but only 0.5 plants/m of row when they emerged with the crop.

White bean — White beans tolerated a ragweed density of only 0.5 plants/m of row when the ragweed emerged with the crop, but 4 plants/m of row when the ragweed emerged at the 2nd trifoliate stage of the crop. The weed densities were based on a threshold of 5%. For example, a grower scouts his/her white bean field and finds ragweed plants emerging at an average density of 4 plants/m of row, at the 2nd trifoliate stage of crop growth. Expected yield losses would be approximately 5%. Then based on his expected yield estimate, the yield loss in dollars can be estimated based on current market value. If the yield loss is $20/acre and the herbicide application will cost $25/acre, do not spray.

Critical periods and economic thresholds however do not apply in the same way to weeds, such as black nightshade, which may reduce the quality of the crop. In such cases the economic threshold may be zero.

Managing Weeds Resistant to Herbicides

Resistance of weeds to herbicides is not a unique phenomenon. In fact, resistance to antibiotics, insecticides and fungicides is a world-wide problem that is not confined to any single pathogenic pest category.

Confirmed cases of pigweed, common ragweed and eastern black nightshade resistance to the Group 2 family of herbicides have been found in Ontario. Some of these pigweed are also resistant to Group 5. Pigweed have also been found to be resistant to some Group 9 herbicides. These reports of resistance are in addition to an already extensive list of 212 weed species throughout the world that are resistant to at least one of the groups of herbicides listed in *Table 3, Herbicide Groupings in Ontario*. In Ontario resistance has been reported to Groups 2, 4, 5, 7, 9 and 22. In western Canada and the United States resistance has developed to Groups 1, 2, 3, 4, 5, 8 and 9 (refer to *Table 3*).

NOTE 1: For control of a particular triazine-resistant species, select an effective non-triazine (non-Group 5) herbicide, or select a tank mix or premix with an effective non-triazine (non-Group 5) herbicide component (see *Table 3*).

NOTE 2: Group 2 ALS resistant weeds. Biotypes of pigweed have been found that are resistant to one or more of the Group 2 herbicides. Resistant strains are difficult to distinguish from susceptible types. For control of a resistant species select an effective non-Group 2 herbicide, or select a tank mix or premix with an effective non-Group 2 herbicide component (see *Table 3*).

Delaying Herbicide Resistance

Herbicide resistance results from a change in a weed population over time after repeated application of the same group of herbicides. The result is reduced weed control in the field. Resistance to different types of herbicides develops at different rates among weed species and populations. To prevent or slow the development of resistant weeds on your farm, take the following common-sense approaches.

1. Identify and Monitor:
Resistant weeds do not look different. Therefore, they are hard to identify. Furthermore, weed "escapes" are common after herbicide application. Resistance does not usually become obvious until 10% –30% of the population become resistant. Survey your fields regularly and apply the methods of diagnosing herbicide-resistant weeds to catch problems as they arise.

2. Prevent the Spread of Weeds:
When entering or leaving a field, clean all implements. Do not allow resistant weeds to go to seed.

3. Use Alternatives to Chemical Weed Control:
Combine mechanical weed control, such as rotary hoeing or cultivation, with chemical weed control where possible.

4. Rotate Crops and Herbicides:
Rotate herbicide usage so that the same herbicide group is not used year after year. One of the easiest ways to rotate to a new herbicide group is to rotate to a new crop. Then use a herbicide from an alternative group. Refer to *Table 3* for help selecting herbicides from different groups. This preplanning will prevent the same herbicide group from being used too often. When it is practical, use tank or formulated mixtures where both active ingredients within the tank act to kill the same weed in a completely different way.

5. Keep Records:
Keep accurate records of crop rotations and herbicide use in all your fields. It will be easier to plan long-term weed management strategies if you have good records.

6. Communication:
Stay in touch with farmer organizations, extension specialists, agribusiness, friends and neighbours about resistance problems they are encountering. Let your government or industry representative know about any cases of resistance so they can take the appropriate action to prevent spread of the weeds.

Diagnosing Herbicide-Resistant Weeds

Before assuming that any weeds surviving a herbicide application are resistant, rule out other factors that might have affected herbicide performance. Those factors are misapplication, unfavourable weather conditions, improper timing of herbicide application, and weed flushes after application of a non-residual herbicide. If resistance appears to be likely, check for the following:

1. Are other weeds listed on the product label controlled satisfactorily? Usually, only one weed species will show herbicide resistance in any given field situation. Therefore, if several normally susceptible weed species are present, reconsider factors other than herbicide resistance.
2. Did the same herbicide or herbicides from the same group (see *Table 3*) with the same site of action fail in the same area of the field in the previous year?
3. Do your records show extensive use of the same herbicide or herbicides from the same group year after year?

If one or more of these three situations apply, it is possible that the weeds are resistant to the herbicide. If resistance is suspected, control the weeds with a labeled herbicide from another group or use appropriate non-chemical weed-control methods to prevent the weeds from going to seed. Next, contact your weed specialist, herbicide supplier and the appropriate chemical company to develop a comprehensive weed-control program to manage the problem.

For more information on herbicide resistance see:

- OMAFRA Factsheet 01-023, *Herbicide Resistant Weeds*
- International Survey of Herbicide Resistant Weeds at: http://weedscience.com/.

Mechanical Methods of Weed Control

Preemergent or "Blind" Harrowing

Blind harrowing consists of waiting until after the crop has been planted, the seed is sprouted and the shoot is about to emerge. At this crucial time, the field is harrowed to kill the small weed seedlings that have already sprouted. The crop will emerge shortly afterwards, having gained a head start on the next generation of weeds. When properly carried out, this method can be most effective in controlling annual weeds in large seeded crops. In cereals, this blind harrowing will often provide adequate control of annual broadleaf weeds. In row crops, it can be used to keep weeds down until the crop plants are large enough to withstand other mechanical control methods. Any type of light harrow can be used. Blind harrowing must not be done on crops underseeded with grass or legumes.

Weeder Harrow

A weeder harrow has spring tines that are gentle enough not to harm the cultivated crop, while uprooting or covering the smaller annual weeds. Therefore, the relative size of the cultivated plants and the weeds is important. Weeder harrowing will be most successful when used as a "blind harrowing". Specially designed weeder harrows have been developed for use on field crops at various stages of development. They can be used most effectively on field vegetables, corn, soybeans and cereals.

Rotary Hoe

The rotary hoe has "fingers" that lift and mix the soil, uprooting small weeds. It is important to work at 10–20 km/hr for satisfactory results. Best results are obtained during late morning or afternoon hours when during late morning or afternoon hours when the hot sun can dry out the uprooted weeds. Also, crop plants tend to be more pliable at this time and injury is reduced. Rotary hoes tend to cause less crop damage than harrows. They are also effective in breaking up a soil crust and mixing surface-applied herbicides into the soil, which will improve the weed control. On light soils or under loose soil conditions, care must be taken to keep the rotary hoe working at a shallow depth.

Inter-Row Cultivation

Shallow inter-row cultivation or scuffling of row crops uproots small weeds and cuts off larger weeds. Various types of equipment can be used but, when shovels are used, allow for up to 50% overlap for thorough weed control. Shields should be used to protect small crops.

Row cultivation can be used profitably when applying herbicides. The herbicide may be more effective and the amount of herbicide used can be reduced, particularly with band applications. To provide adequate weed control in long-season crops, such as corn, scuffling will probably have to be done more than once. The first cultivation is the most crucial since weeds that escape this pass will usually grow to maturity. Here again the relative size of the crop to the weeds is important and probably the limiting factor in achieving 100% success. Blind harrowing, weeder harrows and rotary hoes are used first so that inter-row cultivators produce good results.

Mowing

Mowing or cutting weeds may control weeds in orchards, roadsides, lawns, etc. Harvesting hay or cereal crops also helps to control weeds. Mowing cereal stubble in early August can reduce weed growth and weed seed production, especially if the cereal had been underseeded to another crop such as red clover to compete with the new weed growth. The best time to mow perennial weeds is usually at the bud stage when root reserves are low and before seed set. Note that if a herbicide application is planned for later in the season, adequate time should be left for weed regrowth after mowing. For more information, see individual crop sections.

Use of Chemicals to Control Weeds

Chemicals may be used to control weeds either selectively in crops or non-selectively for the control of perennial weeds or on land not in crops, such as roadsides, fencerows and areas difficult to cultivate. The treatments listed in this publication are based on extensive field and observation on farms. Herbicides should not be used in cold frames or greenhouses unless specifically recommended.

Time of Herbicide Treatment in Crop Areas

The susceptibility of both crops and weeds to herbicides is related to the time of application. Therefore, it is important to use the chemical at a time when the crop is at its maximum resistance and the weeds are at their maximum susceptibility. This time will vary depending on the crop involved and the herbicide used. Terms describing the times at which herbicides may be applied, unless specified differently, refer to the stage of development of the crop plants.

Preplanting Treatments

Preplanting (PP) treatments are applied before the crop area is sown or planted. Some herbicides used in this way act on germinating seedlings, others may also kill weed seeds. When used preplanting, some herbicides must be thoroughly incorporated (PPI) with the soil soon after application. Directions for incorporation are given throughout the publication where these herbicides are recommended.

Preemergence Treatments

Chemicals used in preemergence (PRE) treatments are applied after seeding but before the specified weed or crop emerges. The chemicals may control weeds by (1) killing weed seedlings and/or (2) establishing a toxic layer of chemical on or near the soil surface in which germinating seeds and young seedlings cannot survive.

For successful preemergence treatments the crops must either be tolerant of the chemical at the seedling state or

the toxicity must have disappeared before the crop emerges.

A smooth, well-prepared seedbed that is free of clods is necessary for best results. The surface soil should also be moist and the temperature favourable for the rapid germination of weed seed.

Postemergence Treatments

Postemergence (POST) treatments are applied after the crop and weeds have emerged. A selective chemical is used and the weeds are killed with little damage to the desirable plants. The types of weeds that may be controlled depend on (1) the susceptibility of the weed, and (2) the tolerance of the crop to the chemical. Treatment at the correct stage of crop development is important. Since most weeds are more susceptible to chemicals when young, early treatments will require less herbicide and will result in less damage to crops from weed competition and from spray equipment.

Sometimes a herbicide may be applied postemergence to the crop but preemergence to the weeds. For example, a crop may be cultivated, then a herbicide applied to the weed-free soil to control germinating weeds.

Chemical Weed Control in Non-Crop Areas

Treatment with "Soil Sterilants"

Perennial weeds may be killed and the growth of annual weeds prevented by the use of soil-active chemicals, which are toxic to most plants. These "soil sterilants" may be applied at any time. Best results are obtained if application is followed by a period of rainfall.

Treatment with Translocated Chemicals

In eliminating perennial weeds, heavier dosages of 2,4-D and of other translocated chemicals must be applied than would normally be used in crop land. Mixtures of 2,4-D with other chemicals may be used to keep areas free of vegetation.

Treatment with Contact Chemicals

These chemicals are not selective but kill all foliage they contact. While this will kill annual weeds, regrowth usually develops from the roots or crowns of perennial plants.

Conservation Tillage

All herbicides recommended for use in specific crops in the conventional tillage sections of this publication can be used in conservation tillage systems provided that they are used according to the labeled uses and the labeled rates.

Minimum Tillage involves very little use of tillage equipment for seedbed preparation. The soil, however, is tilled prior to seeding, resulting in somewhat rough planting conditions by conventional standards. There is very little living vegetation and a crop residue cover of more than 20% after seeding. Weed control in this cropping system is similar to weed control in conventional tillage. Preplant incorporated herbicide treatments may not be practical if crop residues are heavy. Good uniform soil mixing is required to produce satisfactory results with incorporated herbicides. If this condition cannot be achieved without extra tillage, then the preferred method would be to use preemergent or postemergent herbicides. Use inter-row cultivation with herbicides. Burndown treatments are not normally required.

Ridge Tillage involves seeding the crop directly into the ridge formed by aggressive cultivation the previous year. The ridge planter skims off 2–5 cm of soil, crop residue, weeds and weed seeds from the top of the ridge and deposits these in the hollows between the rows. Preplant incorporated treatments are impractical with this system. This system is well suited to broadcast and/or banded applications of preemergent or postemergent herbicides. Excellent results have been obtained by band-applying preemergent herbicides at planting time to fresh, moist soil directly behind the seeding unit on the planter. Also, timely cultivation between crop rows while, at the same time, spraying the crop row with postemergent herbicides can provide excellent weed control. The ridging procedure that follows provides additional mechanical weed control. Proper adjustment of the ridge planter and early cultivation after seeding may eliminate the need for a burndown treatment. (A burndown treatment may be required prior to crop emergence if cultivation is delayed after seeding.)

Strip Tillage suggests that only narrow bands of soil in the seeding area are tilled by either power-driven rotovators or fluted coulters. The area between rows is left untilled and the crop residue is undisturbed. Success with preplant incorporated treatments depends on the amount and type of residue, the nature of the specific herbicide and the tilling device used. Row middles are not usually cultivated but could be if appropriate equipment is available for inter-row cultivation. Usually, broadcast application of preemergent or postemergent herbicides is used. Band applications could be used if inter-row cultivation is an integral part of the production system. If vegetation is present at seeding time, a burndown treatment is necessary.

No-Till cropping systems are the most demanding with regards to weed control. The crop is seeded directly into untilled soil with no follow-up cultivation. Weed control depends entirely on herbicides. Burndown treatments are almost always required. Preemergent and postemergent herbicides are used to control weeds throughout the entire growing season. Crop residues may intercept a portion of preemergent herbicide. If rainfall is sufficient to wash the herbicide from the crop residue into the soil, weed control results will be satisfactory. However, if dry conditions follow application, results could be very disappointing. Postemergent foliar-applied herbicides are more appropriate under dry conditions.

Weed Population Shifts

Weed population shifts is a term that refers to the changes in the kinds of troublesome weeds that occur with a change in tillage systems. When tillage is reduced the environment of weed seeds and underground parts of perennial weeds is altered. These environmental alterations affect weed species differently. Deep burial of

weed seeds under conventional tillage systems enforces seed dormancy and increases the life of seeds, perpetuating weed problems. Reducing tillage keeps more weed seeds at the soil surface where they are subject to the ravages of nature. Greater percentages of seed at the soil surface are destroyed before they germinate (by winterkill, birds, insects or rodents). Most seeds that do survive germinate sooner and, if they are controlled, they do not return seeds to the soil. If good weed control is obtained in the early years of reduced tillage, eventually the weed seeds in the soil become fewer, reducing the potential of serious weed problems that originate from seed. Pressure from annual weeds tends to decline after a few years in reduced tillage. On the other hand, reduced tillage favours weeds that reproduce from underground roots and stems; these underground parts are not mechanically injured or destroyed in reduced tillage systems. Perennial and biennial weeds tend to be more troublesome in ridge-till, strip-till and no-till fields. In reduced-tillage fields, these weeds emerge earlier and do not spread as much as they do in conventionally tilled fields. This allows more appropriate timing for spray application and more spot treatments. The most effective herbicides are foliar-applied systemic types that translocate well to underground plant parts before the aboveground parts are killed. When non-selective herbicides are used, perennial and biennial weeds must be treated between crops or the crop must be sacrificed in treated areas.

Burndown treatments are meant to kill existing vegetation before crops emerge. Burndown treatments may be required in minimum tillage, especially when cover crops are used; in ridge-till when seeding is delayed and/or when winter annual, biennial or perennial weeds are present; and almost always in no-till and strip-till fields. Vegetation can be killed by:

- contact herbicides like paraquat
- translocated systemic herbicides like glyphosate, dicamba or 2,4-D
- residual herbicides that have postemergence foliar activity such as atrazine, cyanazine, linuron or metribuzin plus surfactants or oils and
- a contact or systemic herbicide tank mixed with a residual herbicide such as paraquat + atrazine or glyphosate + dicamba.

All of these treatments are most effective on young, actively growing plants. Coverage is extremely important with contact treatments. Burndown treatments do not necessarily provide residual weed control.

When dense, vigourous growing vegetation is present just before or at planting time, large amounts of soil moisture are removed by that vegetation. This can be an advantage during springs when there is an overabundance of soil moisture, but is a definite disadvantage during springs when dry conditions prevail. Because of this situation, consideration should be given to early application of burndown herbicides, perhaps even the previous fall when perennial cover crops or sod fields are involved. Under dry conditions, a rapid-acting burndown would be preferred over a slower-acting treatment.

For more specific information see also the individual crop sections such as Corn (Field and Sweet) and Soybeans.

Applying Herbicides

An exterminator's license may be required by a person applying herbicides on property other than their own domestic property. An operator's license is required by a person operating an extermination business. For further information, contact any Ministry of the Environment Regional Office or the Ministry of the Environment Pesticides Section, 135 St. Clair Avenue West, Toronto, M4V 1P5.

Successful chemical weed control requires the application of the correct quantity of herbicide uniformly over the area. With selective weed control in field crops, this application becomes a precision operation.

The chemical is applied as an emulsion, solution or suspension. The volume of the mixture used per hectare depends on the herbicide and the crop being treated. Generally, low volumes (50–200 L/ha) are used when 2,4-D chemicals are sprayed on emerged weeds, and higher volumes (150–300 L/ha) when preemergence herbicides are applied.

Small areas may be treated with a garden sprayer, or even with a watering can, if care is taken to wet all foliage.

Power equipment is necessary for larger areas. Equipment used for applying 2,4-D-like chemicals should not be used later for applying other solutions to 2,4-D susceptible crops or garden plants.

CHAPTER 2. APPLICATION TECHNOLOGY

Introduction

Herbicide application should be a precision operation. Recent advances in equipment and control systems can make the job relatively simple and precise.

Pesticides applied incorrectly may result in wasted pesticide, poor or no control, damage to crops (possibly the neighbour's) or environmental contamination. Every effort must be made to apply chemicals properly to help eliminate these undesirable effects.

Developments in New Equipment

In building sprayers that accurately apply herbicides, equipment manufacturers work closely with the crop-protection industry. New concepts, such as closed-injection-type systems with herbicide concentrate carried separately from the water carrier, are now in use. Electronic rate controllers provide more accurate spray application by utilizing speed sensors, flow controllers and microprocessors to maintain the desired application rate. This technology has also included radar to accurately sense true ground speed of the sprayer Rate controllers are common among the professional applicators.

The industry is currently working towards the closed-injection system. Work continues in the area of drift reduction using air assists and electrostatic methods.

Nozzle manufacturers have brought to the market air-induction nozzles that significantly reduce spray drift. These nozzles are made by a number of companies and are available in a range of sizes. Operating these nozzles within their working pressure range is crucial to ensure designed spray angle development and proper air induction into the nozzle. Before buying a certain brand of air induction spray tips, make sure your sprayer pump can produce sufficient pressure to operate these tips under all conditions. Check with the nozzle manufacturers for operating pressures required.

Sprayers for Home Use

A 9–14 L backpack, hand-held or compressed-air garden sprayer is satisfactory for use on lawns and around the home. A nozzle tip that produces a fairly coarse spray will help reduce spray drift. Care should be taken to keep the pressure relatively low; high pressures produce more fine spray droplets, which can drift in light winds to susceptible plants. The sprayer should be reserved for use only with herbicides and should **not** be used to apply insecticides or fungicides.

Field Sprayers

The most common sprayer used in herbicide application is the boom-type sprayer. This sprayer applies a uniform amount of spray solution across the width of the boom.

The main requirements for field spraying are:

- a uniform pressure across the whole boom
- all nozzles have the same output and a good spray pattern
- a uniform forward speed in actual field conditions
- a stable boom height to ensure proper overlap of the nozzle-tip patterns

Most commercially built sprayers can be adapted and used safely to apply liquid fertilizers. Extra agitation may be required. Ensure that the sprayer components being used are compatible with the fertilizer formulation and follow the manufacturer's recommendations.

Air-Blast or Mist Sprayers

These machines should never be used to apply herbicides, especially hormone-type herbicides such as 2,4-D. The danger of causing herbicidal damage at a great distance from the treated area is very great.

Wiper Applicators for Selective Weed Control

Wiper applicators (rope-wick, roller applicator or similar device) have been extensively used with glyphosate (ROUNDUP). Check product labels for use of this application technique with other herbicides. Product labels list the crops for which this technique is registered. The main criteria for using wiper applicators are:

- contact enough of the target plant to get herbicidal effectiveness
- keep the wick application above the crop to avoid crop injury.

Travel speeds should be 4–10 km/hr for wick application. Two passes in opposite directions may be beneficial, especially in heavy weed infestations and where higher vehicle speed is contemplated. Care must be taken not to contact sucker growth in orchards, vineyards and shelterbelts. This may result in crop injury. **Follow manufacturer's directions.**

Care and Use of Equipment

Spraying Speeds

Because most agricultural and roadside herbicide must be uniformly applied, the forward speed of a sprayer must be constant whenever the nozzles are delivering liquid. If the driving wheels of a tractor slip on the soil surface, the tractor's speedometer does not indicate a change in forward speed. To be certain that the forward speed is constant in spite of wheel slippage on hills, use an independent speedometer powered by a non-driven wheel. Spray monitors and other electronic rate controllers also may be installed. Only rate controllers will automatically adjust for variation in tractor speed to maintain a constant rate of application.

Water

Use only clean water that contains no debris, sand or mud. On your farm water supply, use a frost-free water hydrant located outside the building. An anti-backflow or anti-siphon valve should always be installed on any hydrant or water supply. Never allow the intake screen to rest on the bottom of a farm pond while filling a sprayer. The intake line near the screen must, by law, be equipped with a check valve or anti-backflow device to prevent contamination of the pond or stream when the pump is shut off. The use of a tank-refilling nozzle, volume-booster nozzle or injection pump to aid in refilling the sprayer tank from farm ponds or streams must be avoided. These tank-refilling aids may cause pond or stream contamination.

Agitation

When chemical formulations in solution are used (2,4-D and water) at least 2–14 L/min should be returned to the tank for agitation within the tank. Higher rates will apply with wettable powders. To be effective, the agitation line from the pump should pass through a control valve and deliver the liquid to the bottom (not the top) of the tank. Agitation nozzles or a sparge tube should always be used to ensure sufficient liquid circulation in the tank.

When wettable powders (atrazine, etc.) are used, the return to the tank should be 14–27 L/min for each 450 L of tank capacity, depending on the concentration of the wettable powder and the size of the tank. A dedicated line from the pressure side of the pump (not the pressure regulator) to the tank must be used to carry the liquid necessary for hydraulic agitation in the tank. Always use a venturi jet or sparge tube. This flow can be reduced if the sprayer has a mechanical agitator. Sparge tube agitation requires more water than venturi to give the same agitation.

Avoid excessive agitation of the mixture, as it may turn into an invert immulsion, a grease-like mass that will settle to the bottom of the tank and cannot be pumped. Excessive agitation may also cause foaming resulting in pumping problems. To prevent a build-up of oil in the sprayer, the tank should be emptied completely before refilling. After any break in the spraying operation, agitate thoroughly before proceeding. Clean the tank and sprayer immediately after use with a detergent or solvent and flush with clean water.

Pumps

The pump is the most important part of the sprayer. The pump should have adequate capacity to maintain the desired pressure, volume and agitation. Piston, diaphragm and centrifugal pumps are the best for pumping wettable-powder suspensions. For liquid herbicide applications, roller pumps may be used in addition to the above types. When used for wettable powders or flowable formulations, choose a pump with an abrasion-resistant housing. Carefully follow the manufacturer's care and storage instructions for the best pump performance.

CAUTION: Running a spray pump without water may cause damage or premature wear.

Nozzle Tips

Numerous companies make spray nozzles. These may be similar in design but may have slightly different setup requirements to get uniform spray coverage. Always follow manufacturers' recommendations for nozzle spacing / nozzle-to-target distances. These distances may vary according to the spray angle of the nozzle. Proper geometry is essential to ensure adequate overlap of adjacent nozzle spray plumes.

Care should be taken to maintain a stable boom height to assure uniform overlap of the nozzle spray patterns.

The success of the spray application is dependent in part by on the condition of the nozzle tips and uniformity of application across the whole spray boom. The spray pattern of all nozzles should be examined prior to their use. In addition, each and every nozzle should be checked when calibration of the sprayer is done.

Materials used for nozzle tips range from brass, stainless steel, hardened stainless steel, as well as plastics/polymers and ceramics. All product formulations and carriers cause wear of the nozzle orifice, wettable powders more than others do.

Sprayers should be calibrated routinely. (See note on calibration below.)

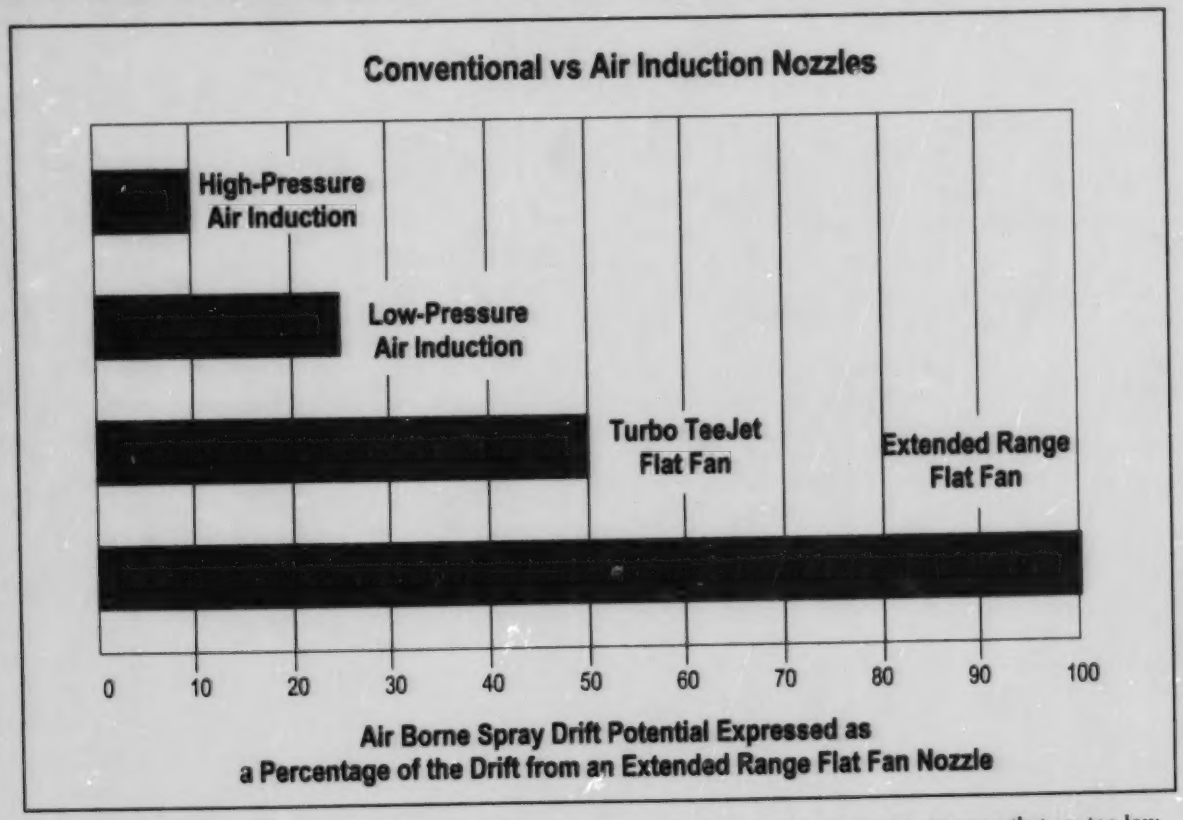
Nozzle tips should be replaced when they deliver 10% more than manufacturer's rated output specifications. Worn nozzle tips may provide uneven distribution of spray solution and cause changes in the spray pattern. This may result in uneven delivery and produce streaks across the field. Flat fan nozzle tips are widely used on boom sprayers to apply herbicides. Spraying operating pressure should be within recommended limits outlined by the nozzle manufacturer. Nozzles with a 110 degree spray angle of 110 degrees have more overlap than 80 degree nozzles. resulting in wider spray angle nozzles allow less chance of spray skips as the boom moves closer to the ground. Always follow manufacturer's recommendations for spacing and minimum nozzle to target distance and spray operating pressures.

Flat fan nozzle tips that will operate at reduced pressure, approximately 140 kPa, are available. These nozzle tips can further reduce the potential of drift.

Air induction or venturi nozzles are now available from at least ten different companies. These nozzles were specifically designed to reduce the amount of fine droplets produced in the smaller nozzle sizes. The nozzle manufacturers offer air induction or venturi nozzles in a wide range of sizes.

These nozzles draw air into the nozzle as the spray liquid passes through the nozzle. The end result is the production of a coarse spray with very few fine spray droplets that are drift prone. These coarse droplets contain air bubbles that cause the droplets to rupture upon impact with plant surfaces.

Air induction nozzles are made in two pressure ranges, low pressure and high pressure. If your sprayer cannot exceed 345 kPa, you should only consider a low-pressure design. All venturi nozzles should be operated in the middle of their working range. For the low pressure designs this is approximately 275 kPa and in the high-pressure designs, about 550 kPa. All venturi nozzle de-



signs are extremely sensitive to low working pressure. The spray patterns will collapse to less than their designed spray angle if the nozzle pressure is too low. This will result in a distorted spray pattern. In addition, the induction of air into the spray liquid will not occur if the pressure goes below a certain point.

Many producers have quickly adopted this new nozzle technology. The significant reduction in spray drift, compared to conventional flat fan nozzles, is a welcome feature. Some producers are using these nozzles for all their herbicide spraying. Some product performance problems have occurred when air induction or venturi nozzles have been used. One or more of the following factors may contribute to this. Poor timing of spray, reduced water volumes, spray pressures that are too low and difficult-to-wet weeds may all contribute to poor control.

Special even-spray nozzlestips are available for band spraying applications of herbicides. These even flat fan nozzles deliver a uniform amount of spray over their sprayed area. A variety of sizes, spray angles and nozzle materials are available. The nozzle-to-target height, and spray angle of the nozzle tips as well as its orientation to the direction of travel, determines controls the width of the sprayed band. Carefully follow manufacturer's literature and directions.

Flooding nozzle tips are used at low pressures and, because of their wide spray angle, can be used closer to the ground surface, thus reducing the drift hazard. New flooding nozzle tip designs have improved the spray distribution patterns to the point that it is as good as with the flat fan tips. Flooding nozzle tips are available in brass, plastic/polymers and stainless steel. Half as many of these nozzle tips are required to cover the same width as would be required with flat fan nozzle tips. Sprayers equipped with a broadcast type of nozzle cover a wide swath. They are especially convenient for farm lane and fencerow spraying where a uniform spray pattern is not essential. The spray pattern is affected by wind and severe drifting may occur with even a light breeze. Never use a broadcast-type of nozzle to spray near a susceptible crop.

Full or hollow cone nozzle tips may be used for applying herbicides to the soil surface when the herbicide is incorporated or mixed into the soil with a disk harrow, cultivator or similar tillage implement.

NOTE: When using any nozzle for spraying wettable powders or micro-nutrients, it is essential to calibrate the sprayer frequently because, as a nozzle wears, the quantity of spray material delivered increases and distribution is uneven. Worn nozzles usually produce will result in a very poor spray pattern.

Nozzle manufacturer's catalogues will list screens required for various nozzle types and sizes. Diaphragm check valve nozzle bodies will ensure dripless operation when the boom is turned off. To clean nozzle screens, remove them from the nozzle bodies and wash thoroughly with soap and water, using a nozzle tip bristle brush. Simply flushing water through the boom and nozzles will not remove pesticide residue that has built up on the outside of the nozzle screens.

Cleaning the Sprayer

Before cleaning the sprayer, dispose of surplus tank mix. As suggested in the Grower Pesticide Safety Course, one method of disposal is to dilute the remaining spray solution at least 10:1 with water. This diluted solution can be applied to the previously treated area as long as the

maximum recommended product rate on the label, is not exceeded.

Clean out the sprayer immediately after finishing the day's work or when changing chemicals. At the end of each spray day, thoroughly flush out the boom with plenty of water to rinse lines, diaphragm check valves and nozzles. Delaying cleanout, even overnight, can allow the formation of hard-to-remove deposits. The sprayer tank is much more difficult to clean out, if it is allow drying. Residue build-up can also result from numerous applications of a herbicide over a period of days or weeks with no cleaning or rinsing in between. Don't forget to also clean out the measuring containers.

Steps:

- Read the product label to determine the recommended cleaning procedure. Have ready all the materials required for the cleanup, including appropriate personal safety equipment.
- Drain spray tank.
- Fill tank with water and add detergent, ammonia or other tank cleaner product and allow to agitate for 10–20 minutes (clean the whole tank not just the bottom half). Flush boom and hoses with solution, allow to stand for several hours (or overnight if possible) and then flush boom and nozzles again and drain tank. When flushing the boom, open the boom ends to get particles out of the boom.
- Inspect inside of tank for visual residues; rinse inside of tank if necessary. Repeat step 2.
- Wash outside of sprayer with soap or mild detergent and water.
- Remove nozzles, screens, and wash separately in a bucket containing cleaning solution. Don't forget to wash out your measuring container with the cleaning solution.

Thoroughly rinse the tank, hoses, booms, nozzles and screens with clean water for a minimum of 5 minutes. Repeat immediately before your next use.

Use household detergent at rate of 250 mL/100 L or 1 kg/150 L of water. Use ammonia (3%) at 1 L/100 L of water. Use other cleaning agents according to label directions. **Never** mix ammonia with chlorine bleach Chlorine gas is produced which may cause severe eye, nose, throat, or lung irritation.

NOTE: Contact the manufacturer of pesticides being used to determine the best methods and product(s) to clean residue from tanks and associated equipment. **Read the label,** since many products, e.g. ACCENT, BANVEL II, CONQUEST, PEAK, etc. provide tank-cleaning information on their label. Some products such as AGRAL 90, or ALL CLEAR, are recommended as tank cleaning agents.

related phenoxy herbicides) or many of the Group 2 herbicides should not be used to spray fungicides or other materials on susceptible crops and should not be parked or stored near greenhouses or other areas where susceptible crops are grown.

Clean the spray tank, booms and hoses first. Be sure to also clean the nozzles and tips, screens, filter, strainer and pump. These parts are often overlooked, and can trap residues. Because of today's highly active, low-use-rate herbicides, it is essential to clean out every trace of herbicide.

When surfactants or fertilizer solutions (e.g., AGRAL 90, 28% UAN) are used in a recommended mix with herbicides, there may be some inadvertent cleaning of previous residues from the tank/equipment that could affect the crop. Proper cleanout when changing products is essential to prevent crop injury.

The wash water contains herbicide. Never allow wash water to run into a well, lake, pond, river or other water source.

Do not leave puddles that may be accessible to children, pets, farm animals or wildlife

Sprayer Calibration

Field Boom-Type Sprayer Calibration

(Determining application rates in L/ha.)

There are many ways of determining the number of litres of spray material that are being applied to 1 ha of land.

Instructions

1. Measure the time.
   - Place 2 stakes 50 m apart in the field.
   - Select the gear and throttle setting (rpm) at which you plan to spray. Half-fill the sprayer with water.
   - Drive the distance between the stakes three times, timing each pass. Each time, make sure the tractor is at the desired speed as you pass the first stake. Keep driving at this speed until you pass the second stake.
   - Note the average time of the 3 passes.
2. Measure the average nozzle output.
   - Park the sprayer with the PTO engaged and the throttle adjusted to reach the PTO speed set in the test run.
   - Adjust the pressure regulator to the desired working pressure with full flow to the boom.
   - Collect the output from each nozzle for the average length of time needed to travel the 50 m in the test run.
   - Enter the nozzle outputs into the equation below.
   - If any nozzle is more than 5% above or below the average output, it should be cleaned or replaced.
3. Measure the nozzle spacing in metres.
4. Use the following formula to determine the sprayer output:

$$\text{Sprayer Output (Litres/hectare)} = \frac{\text{Average Nozzle Output (mL)} \times 0.2}{\text{Nozzle spacing (metres)}}$$

5. Calculate the actual area sprayed after each tank of spray solution is applied. Re-check the sprayer calibration after each tank of spray is applied by dividing the volume sprayed by the area sprayed. The nature of some products may slightly alter the calibration from that of clean water.

6. Growers who prefer to measure in litres/acre or gallons/acre can use the following conversion guide.

   - Litres/hectare × 0.4 = L/acre
   - Litres/hectare × 0.09 = Imp. gal/acre
   - Litres/hectare × 0.11 = U.S. gal/acre

Sample Calculation

Average time to travel 50 m (164 ft) = 24.5 sec

Average amount of liquid collected per nozzle for 24.5 sec = 525 mL

Nozzle spacing on the boom = 0.5 m (≈ 20 in.)

$$\text{Application rate} = \frac{525\ \text{mL}}{0.5\ \text{m}} \times 0.2 = 210\ \text{L/ha}$$

210 L/ha × 0.4 = 84 L/acre

210 L/ha × 0.09 = 18.9 Imp. gal/acre

210 L/ha × 0.11 = 23 U.S. gal/acre

Band Spraying: If the sprayer has 10 nozzles and each nozzle covers a 36 cm (0.36 m) band, the total width of the spray patterns (swath width) is: 10 x 0.36 or 3.6 m.

Note 1: Sprayer-calibration bottles or kits are available from a number of suppliers. For further information contact your local office of the Ontario Ministry of Agriculture, Food and Rural Affairs or manufacturers of sprayers, sprayer parts or herbicides.

Note 2: For banded-spray applications, measure the width of the spray band (at the soil surface or surface of the crop canopy) and enter this value into the formula instead of the "nozzle spacing". Note that in band spraying the acreage sprayed is **not** the same as the crop acreage. (When broadcast spraying a row crop with 1 m rows, the whole field is treated. A band spray may only treat 30 cm over each row. Therefore, only 1/3 of the field is actually treated.) The herbicide rates referred to in most herbicide publications and labels refer to the actual area sprayed unless otherwise stated.

Hand-Held/Backpack Sprayer Calibration

Many people use small hand-held or backpack sprayers for treating problem areas or spraying areas that were missed. Calibration of these sprayers is as important as calibrating your field sprayer.

Method I

1. Measure an area that is 100 sq. m.

   e.g., 10 m × 10 m, or 25 m × 4 m.

2. Fill the spray tank with water. Mark the level on a measuring stick. Pump to the pressure that will be used during the pesticide application.

3. Spray the water over the 100 sq. m area. Walk at a steady pace, taking care to apply it as evenly as possible, just as you would when applying pesticide.

4. Measure the amount of water needed to refill the spray tank to the mark on the measuring stick. This amount will be the sprayer output per 100 sq. m.

Method II

1. Set 2 stakes 50 m (164 ft) apart in the field.

2. Half-fill the sprayer with water

3. Walk the 50 m three times at a steady pace. Calculate your average time to travel the 50 m.

4. Measure the width of the band sprayed by the nozzle (in metres) at your walking pace.

5. Pump the sprayer for the same amount of time as calculated in step #3, collecting the liquid from the nozzle in a measuring device.

6. $$\text{Application rate (L/ha)} = \frac{\text{mL liquid per nozzle} \times 0.2}{\text{Band width (metres)}}$$

Method III

1. Partially fill sprayer. Pump to the pressure you will use during the pesticide application.

2. Spray to determine width of swath (in metres).

3. Walk at a steady pace for 15 sec. Measure the distance (in metres).

4. Multiply spray width times distance traveled to provide the area (in square metres) sprayed in 15 sec.

5. Spray into a measuring device for 15 sec. (Gives amount of solution sprayed in 15 sec.)

6. Application rate (L/ha) =

$$\frac{\text{amount sprayed}}{\text{area (length x width)}} - \frac{\text{L} \times 10{,}000}{\text{sq. metres}}$$

To convert the application rate of any pesticide to the amount required for a small area, follow this guide:

- 1 kg/ha = 10 grams/100 m^2
- for liquid measure, 100 L/ha = 1 L/100 m^2

Source: Ontario Pesticide Education Program Manual 1995.

Determining Amount of Herbicides Needed

Determining amount of product per hectare

Most rates suggested in this publication are given in terms of both active ingredients (common name) per hectare and product (TRADE NAME) per hectare. However, where the amount of active ingredient in the formulations varies considerably (for example, 2,4-D is available in concentrations of 100 g/L, 400 g/L, 500 g/L, etc.) The rate is given in terms of active ingredient only.

Note: Throughout the Crop Recommendations sections of this publication, the common name of each herbicide (its active ingredient) is printed in lowercase letters (e.g., atrazine, dicamba, glyphosate), whereas the product trade name (the name of the liquid or powder etc., inside the container as supplied by the manufacturer) is printed in capital letters (e.g., AATREX, BANVEL II, ROUNDUP TRANSORB), and its formulation is listed within brackets following the trade name.

Determining amount of product required per tankful

After determining how much commercial product is needed per hectare, calibrate the sprayer and determine the number of hectares each tank will cover. Determine the quantity of herbicide needed to add to the spray tank using the following formula:

Product required/tank = hectares covered by tank × product rate/ha

Sample calculations:

(a) product/tank = 4.1 ha × 2.2 kg/ha
= 9.02 kg LOROX/tank

(b) product/tank = 4.1 ha × 4.5 L/ha
= 18.45 L ATRAZINE/tank

Follow manufacturer's recommendations on mixing order and procedures.

Materials, Mixing and Mixtures

Dry herbicide formulations include granules, soluble powders and wettable powders. Granules do not require prior mixing into a slurry. They are ready to be mixed in water. Soluble powders can be dissolved in water. Wettable powders will not dissolve but will form a suspension that requires constant agitation.

Liquid herbicide formulations either mix in water to form a solution or may be oil-based and form an emulsion that will require agitation.

Pesticide labels usually provide mixing directions for registered tank-mixes, often describing the order of mixing. Whenever a label provides mixing directions, they should be followed. Consult the package labels for information on the compatibility of different herbicide products as certain formulations may react when mixed together, resulting in materials with different properties and activities than the original ones. If the pH or hardness of the water needs to be adjusted, adjustments should be made prior to the addition of other spray material in the tank.

When the label does not provide mixing instructions for a registered tank-mix, pesticides should generally be mixed using the following procedure:

- Fill the spray tank with water to ½ of the total spray volume required and start agitation. Add the different formulation types in the order listed below, allowing time for complete mixing and dispersion after adding each product.
  1. dissolvable packs
  2. wettable powders
  3. water dispersible granules and dry flowables
- Maintain agitation and fill spray tank to ¾ of total spray volume. **Then add:**
  4. water-based solutions
  5. emulsifiable concentrates
  6. spray adjuvants
- Finish filling the spray tank to the required volume, maintain continuous agitation during mixing and final filling, and throughout application.

Mixtures of different herbicides or mixtures of herbicides with pesticides or foliar fertilizers should **not** be applied in a single application unless registered for use in this way.

Unless specifically mentioned in this publication, or on a herbicide label, the addition of a surfactant or a detergent to a spray solution is **not** recommended.

Where water is known to have an excessive salt content, compatibility of the water and the chemical at field strength should be tested first on a small scale. See note on Agitation in Care and Use of Equipment.

Application Indicators

Colourants/Foam Markers for Pesticides Application

Colourants added to the pesticide solution help show where pesticides have been applied. Foam marking systems help minimize overlap. Adding a colourant to the basal sprays of herbicides on cut stumps of woody plants helps assure thorough coverage without respraying. Water-soluble colourants can also be useful in lawn spraying. Examples of colourants are listed below.

- Blazon: blue, water soluble
- Bas-oil Red : red, oil soluble
- Dye Red Foam

Colourants are available through agricultural chemical dealers.

Additional Information

Video No. 39, *Field-Crop Sprayer Calibration*

No. 44, *Nozzle Selection for Field Sprayers*

Available from:

Independent Study, University of Guelph,
Guelph, Ontario Canada N1G 2W1.
Phone (519) 824-4120 ext. 3375.
www.uoguelph.ca/istudy/product.htm

OMAFRA Factsheets

00-103, *Reducing Pesticide Drift and Crop Damage*
00-099, *Pesticide Contamination of Farm Water Supplies*
96-025, *Ways to Avoid Pesticide Spills*
94-037, *Pesticide Handling Facility*
89-110, *Flat Fan Nozzle Tips For Field and Weed Sprayers*
88-129, *Field Sprayer Calibration*
87-057, *Pesticide Container Rinsing*

Pesticide Regulations

[redacted]

Pesticide Schedules in Ontario

The Ontario Ministry of the Environment reviews each pesticide product offered for sale in Ontario and classifies it into one of 6 groupings called Schedules.

Sch.	Who Can Use It	Pesticide Characteristics*
1	– licensed applicator – certified grower – only with approved permit	– very toxic and/or – very persistent and/or – highly mobile
2	– licensed applicator – certified grower – trainee or technician under supervision (some restrictions apply) – assistant agriculturist under supervision	– toxic, and/or – persistent, and/or – moderately mobile
3	– any person	– moderately toxic, and/or – moderately persistent, and/or – slightly mobile
4	– any person	– low toxicity – non-persistent – non-mobile – containers < 1 kg < 1 L
5	– licensed applicator – certified grower – assistant agriculturist under supervision	– very toxic and/or – very persistent and/or – highly mobile – less toxic or less persistent alternative not available
6	– any person	– low toxicity – non-persistent – non-mobile – containers > 1 kg > l L

* Biological persistence and mobility in the environment, as expected under normal use conditions for Ontario.

Certification and Training Requirements

You must be a Certified Grower or a Licensed Applicator (Exterminator) to buy and use Schedule 1, 2 and 5 pesticides.

Pesticide Certification for Ontario Farmers

Regulation 914 of the *Pesticides Act* makes it mandatory for farmers to be certified through the **Grower Pesticide Safety Course** to buy and use Schedules 1, 2 or 5 pesticides on land they farm.

- There must be at least one Certified Grower for each farm operation.
- Under the *Pesticides Act*, you are a grower (farmer) if you:
  - currently use farm land for agricultural or forestry production, and
  - that farmland is classified as farmland property under Section 7 of the *Ontario Assessment Act*.

Training for Agricultural Assistants Using Schedule 2 or 5 Pesticides

As of January 2000, all assistants must have formal pesticide safety training, recognized by the Ministry of the Environment, before they can handle or use Schedule 2 or 5 pesticides under the supervision of a Certified Grower.

- This applies to all assistants, including family members, farm employees and seasonal workers.
- Trained Assistants do not have to write an exam.
- Trained Assistants must be 16 years of age or older.
- There are 2 training options for assistants. Assistants can:
  - attend a Grower Pesticide Safety Course and not write the certification examination, or
  - attend an on-farm training session presented by a qualified Trained Assistant Instructor.
- For more information and a listing of Grower Pesticide Safety Courses and exam-only session dates and locations, check the Ontario Pesticide Education Program Web site at www.ridgetownc.uoguelph.ca/opep/.
- To register for a Grower Pesticide Safety Course or GPSC Exam-Only Session (if you are renewing your certificate) anywhere in Ontario, or for information about Trained Assistants please:
  - call 1-800-652-8573,
  - fax !-519-674-1589
  - e-mail opep@ridgetownc.uoguelph.ca

Certification and Licensing for Commercial Applicators

If you plan to apply pesticides as a business, you must be a Licensed Exterminator.

This includes farmers who custom apply pesticides for other farmers and charge a fee for this service. Licensed Exterminators who are self-employed must hold an Operator Licence as well as the appropriate exterminator licence. Exterminator licenses are valid for 5 years.

To become a Licensed Exterminator, you must:

- complete a home study course and certification exam through Ridgetown College, University of Guelph, **and**
- send proof of certification (letter of successful completion of the exam(s)) and a fee to the Ministry of the Environment to obtain your exterminator licence.

Training for Technicians Assisting Licensed Exterminators

Technicians can mix, load or apply all Schedule 3, 4 and 6 pesticides and most Schedule 2 pesticides (some restrictions apply), under the indirect supervision of a licensed exterminator. Technicians cannot mix, load or apply Schedule 1 or 5 pesticides. Technician cards are valid for 2 years.

To become a technician, you must:

- complete an MOE-approved academic course and exam, **and**
- complete practical training with a licensed exterminator.

For more information about certification and licensing requirements for licensed exterminators and training for technicians, contact Ontario Pesticide Training & Certification:

- call 1-888-620-9999
- fax to 519-674-1585
- check the Web site at *www.ridgetownc.uoguelph.ca/optc*

General Precautions

Learn about the health hazards and toxic properties of the pesticide you are using. Consult the product label, Material Safety Data Sheets (MSDS), or manufacturer for this information. Check the company Web sites for MSDS information.

Protect Yourself When You Use Pesticides

- **Make sure someone knows** where you are working, what pesticides you are handling and how long you expect the job to take.
- **Post emergency numbers**, including the Poison Information Centre and Spills Action Centre near all of your telephones.
- **Keep a list of the names and the Pest Control Products (PCP) Act Registration Numbers of all the pesticides you handle**. It's a good idea to keep a file of the pesticide label booklets for all the products you use. Make sure that your co-workers and family members know where this list or file is in case of an accident.
- **Have plenty of clean water, soap and paper towels and an extra set of gloves and coveralls nearby at all times** in case pesticide contaminates your clothing or skin.
- **Wear the correct protective clothing and equipment, and be sure that all items are clean and in good repair before you put them on.**
- **Never smoke, chew tobacco, eat or drink when you handle pesticides.** Never carry tobacco or food in your clothes — and never leave tobacco, food or beverages in areas where you handle or store pesticides.
- **Change your clothes and wash your hands and face before you eat, drink or smoke.**
- **Wash your hands before you use the toilet**, as well as after. The skin in your groin area absorbs pesticides very easily.
- **Pregnant women should not handle or use pesticides.**

Protect Other People, Livestock, Pets, Water and Sensitive Crops

- Buy and store only what you need.
- Prevent drift.
- Keep pesticides out of water.
- Clean up spills quickly and safely.
- Dispose of containers and waste pesticide safely.

Read and Follow Pesticide Label Information

Know the Hazard Symbols and Words

Four important symbols and words show the potential hazards of pesticides.

Hazard Symbol	Signal Word
	Poison
	Corrosive
	Flammable
	Explosive

The hazard symbol will always appear inside one of the shapes shown below. These shapes and their warning words tell you the degree of hazard of the pesticide. **The greater the number of sides to the shape, the more hazardous the product.**

	Warning Symbol	Signal Word
Triangular shape means low hazard (3 sides)		**Caution**
Diamond shape means moderate hazard (4 sides)		**Warning**
Octagonal shape means high hazard (8 sides)		**Danger**

Check the label for special warnings about eye hazards and skin hazards.

The front panel of the pesticide label may also contain warnings that tell you the product is corrosive to eyes, or is a skin or eye irritant.

Re-Entry Periods

Re-entry period is the minimum amount of time that must pass between the time pesticide was applied and the time that workers can go into the crop without wearing personal protective equipment. If workers enter fields without wearing protective equipment too soon after pesticides have been applied, they may experience poisoning. Such poisoning can result from handling treated plants or from inhaling pesticide vapours. Some pesticides, like parathion, have labels that carry a warning about working in treated crops. Follow the label recommendations.

Days to Harvest (Preharvest) Intervals, Pre-Grazing and Feeding Intervals

These intervals state the minimum amount of time that must pass between the last pesticide application and the harvesting of the crop, or the grazing or cutting of the crop for livestock feed. If you harvest a crop before the Pre-Harvest Interval has passed, there may be pesticide residues in excess of the Maximum Residue Limits (MRL) set by Health Canada. When crops with persistent residues are fed to livestock, the pesticides may poison the animal or may contaminate the milk or meat.

Crop Rotation Statements

Some pesticides can persist in treated soil and crops sensitive to that pesticide may be injured if they are planted too soon after the treated crop is harvested. Some labels will state a minimum waiting time that must pass before it is safe to plant sensitive crops (See *Table 2, Herbicide Crop Rotation and Soil pH Restrictions*).

Total Number of Applications

Some product labels will state the total number of applications of that pesticide that can be made during a growing season. These limits prevent food residues, crop damage, soil residues or pest resistance.

Buffer Zones

Buffer zones are areas left untreated to protect an adjacent area, for example a pond, a stream, a sensitive crop, a non-target crop, wetland or woodland etc.

Human Health

Risks of Pesticide Use

Each time you handle a pesticide, you are at some risk. The amount of risk depends on two things –the toxicity of that pesticide and your exposure to it.

Risk = Toxicity x Exposure

Toxicity is a measure of how harmful or poisonous the pesticide is. There are 2 types of toxicity:

- **Acute toxicity** — the toxic response that results from a **single exposure** to the pesticide. The symbols and words on the front panel of a pesticide label give you information about the acute toxicity.

  Lethal Dose 50% (LD_{50}) is a measure of Acute Toxicity. It is the dose (mg of product per kg of body weight) that will kill 50% of the test animals within a stated period of time (24 hr.–7 days).

- **Chronic toxicity** — the toxic response that results from repeated exposures to small doses of a pesticide over a longer period of time. These toxic effects may not appear for months or years after exposure to the pesticide. The symbols on the label do NOT give information about the chronic toxicity of the product. Use protective clothing and equipment to help reduce exposure and the risk of chronic effects.

Cholinesterase Blood Tests

Organophosphorus and *carbamate* pesticides can affect your nervous system. These pesticides can change your serum and red blood cell levels of an enzyme called acetyl cholinesterase. Your body uses this enzyme to transmit messages through your nervous system. If your cholinesterase levels fall, you can experience symptoms including trembling, twitching, blurred vision, difficulty breathing and heart difficulties.

If you use any of these pesticides on a regular basis, you should have regular cholinesterase blood tests. Your family doctor can arrange these tests, and they are covered by OHIP. **Have your first test before you begin to handle these pesticides**. That will show the baseline (normal) cholinesterase level for your body. During the spray season, if you are spraying organophosphorus or carbamate insecticides regularly for several weeks, you should have a cholinesterase blood test every **7–10 days**. If your cholinesterase level drops to below one-half of your baseline level, then you are showing signs

of pesticide poisoning and **you must remove yourself from exposure** to these pesticides until your cholinesterase level returns to normal.

Exposure is a measure of the contact you have with the pesticide. You can be exposed to the pesticide in 3 ways.

- **Dermal Exposure** occurs through your skin or eyes. The amount and rate of pesticide that may be absorbed depends on several things, including:
  - your skin condition. If your skin is moist, or if you have a rashes, broken skin or scratches, pesticide will be absorbed more easily
  - the part of your body that is exposed. Your eyes, genital area, scalp and ear canals absorb pesticides at a higher rate than your hands or arms. Your eyes absorb pesticides at a rate of 100%.
- **Respiratory Exposure (Inhalation)** occurs when you inhale small spray particles, dust, gases or vapours.
- **Oral Exposure** occurs when a pesticide enters your mouth or you swallow a pesticide.

First Aid

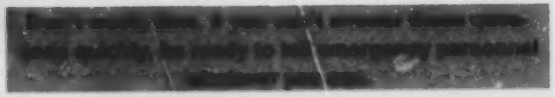
1. **Always protect yourself from injury first**. Don't become another victim. Always put on protective clothing and equipment before you enter a contaminated area or handle a contaminated victim.
2. **Check to see if the victim is breathing.**

   If the victim is not breathing:

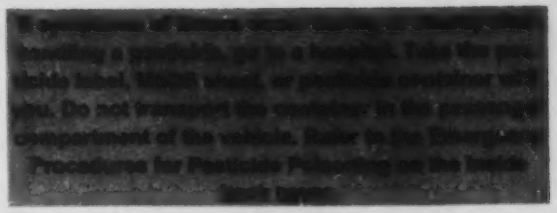
   - Straighten the victim's airway and check for breaths.
   - If the victim does not begin to breathe, administer artificial respiration until the victim begins to breathe on his/her own.
   - Do not contaminate yourself, especially if the victim has pesticide or vomit around his face or mouth. Use a face shield airway with a one way valve. Do not breathe the exhaled air from the victim.
   - Perform CPR if the victim's pulse disappears. You should only perform CPR if you are trained to do so.

   If the victim is breathing, but unconscious:

   - Place the victim in the recovery position (on the side with the head turned slightly to one side). If the victim vomits, try to keep the airway clear.
3. **Stop the exposure to the pesticide.** Move the victim away from the contaminated area. Remove all contaminated clothing. Use soap and water to wash any skin exposed to the pesticide.
4. **Check the Four Basic Facts:**
   - **Identify the pesticide**. Look for the label, container or leftover pesticide.
   - **Quantity.** How much product was the victim exposed to?
   - **Route of entry.** How did the pesticide enter the body? Did it enter through the mouth, skin/eyes or lungs?
   - **Time period.** How much time has passed since the victim was exposed to the pesticide, and how long was the exposure? Were the symptoms immediate or did the poisoning occur as a result of using the pesticide over a longer period of time?



5. Call an ambulance or the Poison Information Centre.
6. Start the First Aid treatment appropriate for the route of entry.
7. **Make sure the patient gets medical attention.** First aid is **not** a substitute for professional medical help.



EMERGENCY AND FIRST-AID PROCEDURES FOR PESTICIDE POISONING
(Refer to the inside back cover.)

Protective Clothing and Equipment

Choose and Wear the Appropriate Protective Clothing and Equipment

Make sure your protective clothing and equipment:

- is what you need for the job
- fits properly, and
- is clean and in good repair and working condition.

The protective clothing and equipment you need to wear depends on:

- **the pesticide you are using.**
  READ THE PRECAUTIONS SECTION OF THE LABEL TO KNOW WHAT TO WEAR
- **the job you are doing.** For example, you need more protection when you handle concentrated pesticide or when you mix and load your sprayer.
- **the type of application.** Enclosed space or air blast sprayer applications made with open tractors require more equipment.

Each person who is working with pesticides needs **their own** set of protective clothing and equipment. Consult the technical expert at your safety supply company to make sure that you purchase the appropriate equipment and that it fits the user.

For ALL pesticides, you should always wear:

- Water repellent hat, like a hard hat or waterproof rain hat. Do not wear hats made from cloth.
  - Baseball-style caps absorb pesticides and are not safe.
- Long pants and a shirt with long sleeves, or a coverall.
  - Coveralls can be reusable or disposable. Reusable coveralls are normally cotton or polyester and should be tightly woven.
  - Cotton, denim and cotton-polyester fabrics can absorb pesticides and transfer pesticides to your skin. If you spill pesticide on your clothing, remove the clothing immediately.
- Chemical resistant gloves (unlined)
  - Use neoprene or nitrile gloves, unless the label states otherwise. Do not wear rubber gloves as many pesticides can break down the rubber material. Wear your gloves under your sleeves with the top cuffed.
- Chemical resistant boots (unlined)
  - Wear your pant legs over your boots to prevent pesticide from running down inside of your boots.

Read the label. It will describe what extra protective clothing and equipment to wear. For some pesticides you may also need to wear:

- Goggles
  - Use safety goggles. Regular eyeglasses don't provide complete protection. Never wear contact lenses when you handle pesticides.
- Face shield
- Chemical Resistant Apron
- Respirator
  - A respirator is a unit that covers your mouth and nose to prevent spray droplets, small particles, and vapours from getting into your lungs. **A dust mask is not a substitute for a pesticide respirator.** Make sure you use cartridges and pre-filters that protect you against organic vapours when you buy a respirator or replacement cartridges. For more information about respirators, refer to the *Grower Pesticide Safety Course Manual*, Ridgetown College, University of Guelph.

You may need more protection, such as Canister Gas Masks or Self-Contained Breathing Apparatus (SCBA) when you apply:

- any pesticide in an enclosed area, or
- fumigants, gases, vapours or smokes

[redacted]

Use Organic Vapour Tractor Cab Cartridges

If you use a tractor with a cab when you spray, these tractor cab cartridges work the same way as an air-purifying respirator. These cartridges and pre-filters **must** be replaced and maintained on a regular basis to provide continued protection.

When you use air blast sprayers and mist blowers and tractors without cabs:

- wear the appropriate respirator, as well as a waterproof suit, head covering, chemical resistant gloves, boots, and eye protection. Once you complete the spray application, clean your protective equipment and the tractor. Do not operate the tractor without wearing protective clothing and equipment, unless it has been decontaminated.

Safety Supply Companies

Consult the safety supply companies of your choice for help in selecting your protective clothing and equipment. (See Table C, next page.)

Care of Protective Clothing and Equipment

- After you complete the spray operation, clean all protective clothing and equipment.
- Never let children, pets or livestock come in contact with contaminated clothing or equipment — and also make sure that they cannot come into contact with the puddles of water that result when you clean your equipment.
- **Wash your gloves with soap and water and then leave them on to remove your other protective clothing and equipment.**
- Always remove protective clothing and equipment outdoors. If a granular pesticide was used, shake the clothing outdoors in a safe place, emptying pockets and cuffs.
- Clothing that has been contaminated by spills of highly toxic or concentrated pesticide should be thrown out. Place clothing in a plastic bag and take it to a landfill site.
- **Coveralls and other spray clothing must be washed separately from other clothes.** They should be washed after each use. Place them in a plastic bag and keep them separate.
- With your hands still protected by gloves, wash protective equipment. It is best to wash equipment outdoors. If you do not have an outside clean-up area, keep certain buckets just for equipment clean up. Mark them and keep them in a special place. Wash the inside and outside of your goggles, hat, boots, and any water-repellent clothing in warm soapy water, rinse well and let them air-dry.

TABLE C. Safety Supply Companies in Ontario Providing Protective Clothing & Equipment

3-M Canada Inc.	Occupational Health and Environmental Safety, Box 5757 London, ON N6A 4T1	(519) 452-6165 1-800-364-3577 Fax: (519) 452-4660
Acklands Grainger	90 W. Beaver Creek Rd. Richmond Hill, ON L4B 1E7	(905) 731-5516 1-800-668-8989 Fax: (905) 731-2798
Aearo Canada	7115 Tomken Rd. Mississauga, ON L5S 1X7	(905) 795-0700 1-800-387-4304 Fax: (905) 564-5250
Dutch Industries " Protect-Air Cab Filter"	Huron Tractor, Box 1300 Exeter, ON N0M 1S3	(519) 235-1115 Fax: (519) 255-1939
HAMISCO	3392 Wonderland Rd. London, ON N6L 1A8	(519) 652-9800 1-800-668-9800 Fax:(519) 652-9661
Kappler Canada	Box 1687 20 Ryan Place Brantford, ON N3T 5V7	(519) 752-4369 1-800-387-9326 Fax: (519)752-2161
Levitt-Safety (Eastern) Limited	2872 Bristol Circle Oakville, ON L6H 5T5	(905) 829-3299 1-800-668-6153 Fax: (905) 829-2919
MSA Canada Inc.	148 Norfinch Dr. North York, ON M3N 1X8	(416) 667-9400 1-800-267-0672 Fax: (416) 663-5908
Mitt & Robe Co.	751 Norfolk St. N. Simcoe, ON N3Y 3R6	(519) 428-4050 1-877-893-6565 Fax: (519) 428-5142
Plant Products Co. Ltd.	314 Orenda Road Brampton, ON L6T 1G1	(905) 793-7000 1-800-387-2449 Fax: (905) 793-9632
Safety Express	4060B Sladeview Cres., Unit 2 Mississauga, ON L5L 5Y5	(905) 608-0111 1-800-465-3898 Fax: (905) 608-0091
The Saint George Company (Suppliers of Kasco Helmets)	P.O. Box 430 20 Consolidated Drive Paris, ON N3L 3T5	(519) 442-2046 1-800-461-4299 Fax: (519) 442-7191

- Remove the cartridges and pre-filters from the respirator.
- Discard cartridges, canisters and filter pads when breathing becomes difficult, or when you notice a pesticide taste or odour, or at the interval set by the manufacturer.
  - Make a note of the date the cartridge is first used.
  - Remove cartridges and filter pads from the face piece and store in clean, sealed plastic bags.
  - Wash the face piece in warm soapy water, rinse thoroughly, and dry in a well-ventilated area. Air-drying prevents damage to the inlet and outlet valves.
  - Never use alcohol or other solvents for cleaning, as they will damage the rubber and plastic.
- Next wash the outside of your gloves with soapy water and remove them.
- After removing boots and gloves, wash them inside and out with detergent and water, rinse thoroughly, and dry in a well-ventilated area.
- Place all dry articles in a clean storage area until next use.

How to Wash Your Spraying Clothes

Never mix spray clothing with household laundry. All clothing used for spraying must be stored and washed separately from other clothing. They should be washed after each use. **Remember to use chemical resistant gloves to handle pesticide-contaminated clothing.**

- Presoak clothing before washing. Use one of three methods:
  - hose off garments outdoors
  - soak in separate tub or pail
  - use the prewash cycle in automatic washer.
- Place clothing directly into the washing machine. Wash only a few garments at a time. Do not wash with other family clothes.
- Use hot water, the highest water level, and the longest cycle, with heavy duty detergent. Wash as you would for heavily soiled clothing.
- Wash clothing again.
- After washing, hang outside (preferably in bright sunlight) until completely dry. Do not use the clothes dryer.
- Clean the washing machine. Run the washing machine through one complete cycle using only detergent and hot water. (No clothing).

Personal Hygiene

- **When you are finished for the day, take a bath or shower as soon as possible.** The longer a pesticide remains on your skin, the greater the risk that it will be absorbed into your body.
- Always shower before eating, drinking, or smoking. Wash your hair and under your fingernails. Shower with lots of soap and water.
- Always change into clean clothes.
- Wear clean work clothes every day. A small spill on the previous day's clothes may seem unimportant, but wearing the same clothing again without washing it prolongs the exposure and increases your risk.

Protect the Environment

Protect Water Sources

- You must use an anti-backflow device to prevent back siphoning when drawing water from wells, ponds, streams or other sources.
- Mix pesticide and load the sprayer **at least 50 m away** from any water supply, including wells, ponds or streams.
- Use buffer zones (untreated areas) when you apply pesticides to avoid contaminating surface water, wells, ponds and/or streams. Check the product label for specific buffer zone distances.

Reduce and Manage Pesticide Spray Drift

Spray only when winds are light to moderate. If you notice drift is occurring because of the wind, **stop spraying** until the wind subsides. Do not apply pesticides if the wind is blowing towards susceptible crops or environmentally sensitive areas such as watercourses.

- Read the product label for information regarding buffer zones, water volumes and recommended nozzles.
- Use buffer zones around all watercourses and wells and neighbouring fields that contain sensitive crops. If the label does not state a specific buffer zone distance, leave an untreated area of natural vegetation.
- Select the recommended sprayer application rate (L/ha).
- Select the correct nozzle. Where practical, use air induction/venturi nozzles. These nozzles significantly reduce drift when compared to conventional nozzles.
- Select the correct nozzle-to-target distance.
- Use spray plume protection where practical or available (hoods, shrouds, screens and air curtains).
- Use drift-reducing adjuvants in the spray tank as directed by the label.
- Utilize wick weeders, instead of spraying, when possible.

For more information about spray drift consult OMAFRA Factsheet, *Reducing Pesticide Drift and Crop Damage*, Order No. 00-103, OMAFRA/ Agriculture and Agri-Food Canada booklet *Best Management Practices Pesticide Storage, Handling and Application* and the Ontario Pesticide Education Program (Ridgetown College) videos *How to Manage Spray Drift and Spray Drift Reduction through Air Induction*.

Prevent Bee Poisoning

It is important to protect bees when you spray. Honeybees, as well as other bees and insects, are important pollinators of crops. Many crops also offer bees important sources of pollen for honey production.

If you choose to use insecticides for insect control, take these steps to prevent harming bees when you spray:

- Before you apply a pesticide, advise local beekeepers so that they can move colonies out of the danger area. Contact the Provincial Apiarist at **1-888-466-2372** for a list of the beekeepers in your area.
- Do not spray any flowering crop on which bees are foraging. If you must apply insecticides, spray after 7 p.m. when the bees are not foraging. If this is not a possibility, spray before 7 a.m. Bees usually do not forage at temperatures below 13°C.
- Do not apply insecticide on windy days to prevent drift toward any nearby hives.
- When there is a choice, choose the product formulation that is less hazardous to bees. Dusts are more toxic than sprays. EC formulations are less toxic than WP formulations.
- Under the *Bees Act* it is an offence to spray in orchards while there is bloom on the trees.

Most organophosphate and carbamate insecticides are highly toxic to bees.

Disposal of Pesticides and Empty Pesticide Containers

Triple or Jet Rinse Your Empty Pesticide Containers

Unrinsed pesticide containers are not really "empty". They may still hold about 1% of the original amount of pesticide. Although this figure sounds low, it is still a hazard to humans, animals, and the environment. To reduce the hazard, rinse each container 3 times as the spray tank is filling. Use either the manual triple rinse technique, or a specially designed device for rinsing containers. Paper or cardboard containers are often

strong enough to be rinsed. If it is possible, rinse these containers as well as plastic ones.

To Triple Rinse

1. Fill the empty container at least 10% full of the diluting material (usually water).
2. Cap, then shake or roll the container so that the inside surfaces of the container are well rinsed.
3. Pour rinsings into the spray tank.
4. Repeat steps 1–3 twice more.

Remember to check the container after you have finished rinsing. Make sure that no pesticide has been left behind as a cake or paste on the bottom of the container.

Rinsing Devices

Rinsing devices use pressurized water to clean out the container. They are just as effective as triple rinsing but take less time. Follow the manufacturer's instructions.

How to Dispose of Empty, Triple Rinsed Containers

Never re-use empty pesticide containers. They may be handy, but there is still some risk even if the containers are triple rinsed. Never give empty, rinsed containers to anyone, especially not children. Dispose of them promptly.

Regulation 914 of the *Pesticides Act* regulates how pesticide containers are to be disposed of in Ontario.

For Metal, Plastic, or Glass Containers

An empty metal, plastic, or glass container that has been used to hold a Schedule 1, 2, 3*, 5 or 6* (*non-domestic) pesticide shall be disposed of by triple rinsing or jet rinsing using clean water, or another appropriate solvent;

AND either

- taking it for recycling to a pesticide container depot;

OR

- taking it to a licensed waste disposal site. (Reg. 914, s. 27)

Once containers are properly rinsed, they should be punctured to make it impossible to use them again and to make sure the rinse water is out of the container.

It is often more convenient to store empty, rinsed containers until you have collected enough to make a trip to the recycling pesticide container depot or the waste disposal site. If you store containers, keep them in a dry safe place, such as the storage area, until you can dispose of them properly.

Recycling

The Ontario Pesticide Container Recycling Program is available to growers and commercial applicators. Through this program, **clean, triple rinsed, plastic/metal pesticide containers** (up to 23 L in size for plastic and 20 L in size for metal) can be returned to pesticide container depots located throughout the province. To locate the pesticide container recycling depot closest to you, call the Ontario Pesticide Education Program at 1-800-652-8573.

A recycling pesticide container depot has been established by Future Farm Supply in Aylmer, to collect empty metal drums that contained sucker oil and fumigants used in tobacco and fruit production.

For Paper and Cardboard Containers

A paper or cardboard container that has been used to hold a Schedule 1, 2, 3*, 5 or 6* (*non-domestic) pesticide shall be disposed of by triple rinsing or jet rinsing (if possible) using clean water

AND either

- burning, (if allowed by municipal by-laws) in circumstances that persons and animals are kept out of any smoke produced and any smoke is directed away from buildings, highways, roads, or outdoor areas frequented by the public;

OR

- taking it to a licensed waste disposal site. (Reg. 914, s. 27)

Paper or cardboard containers are often rigid enough to withstand rinsing. If it is possible, triple rinse these containers as you fill the tank. Then burn the containers in an isolated area on your farmland.

Be very careful around the smoke. It may contain toxic fumes from the burning pesticide. Be certain that there is no chance that a person or animal may breathe in this smoke. Make sure that the smoke does not drift toward buildings, roads, or any public outdoor areas.

These containers can also be taken to a local waste disposal site in the same way as metal, plastic, or glass containers. If you can't dispose of them immediately, make sure containers are kept in a secure place such as the pesticide storage area.

Unwanted Pesticides

If you have pesticides that you do not need or cannot use, be sure to dispose of them safely.

- Contact the supplier. It is sometimes possible to return unused pesticide if it is still in its original container.
- If you cannot find any way to use the product as shown on the label, then the Ministry of the Environment requires that waste be disposed of by licensed waste haulers to a licensed waste disposal site. Look in the Yellow Pages of your telephone directory under "Liquid Waste Removal".
- Watch your local paper for "Municipal Waste Collection Days" or contact your municipality. If your municipality has no waste collection days, encourage them to sponsor such an event. On these days, you can turn over surplus pesticide concentrates (maximum 25 L) for disposal.
- Consult with the regional Ministry of the Environment Office for additional information. The Ministry of the Environment has an agreement with Safety-Kleen for the disposal of unwanted pesticides

on a user-paid basis. Contact Safety-Kleen in London, Ontario at (519) 451-6630 for disposal of unwanted or contaminated pesticides

Surplus Spray Mix

The best way to dispose of any excess spray mix is to find other fields that require an application of this pesticide. Before spraying, check the label to make sure the pesticide is registered for use on that crop.

If you can't find another field to spray, then dilute the remaining spray mix by adding 10 parts of water for each 1 part of spray mix. This diluted solution can be safely applied to the treated area as long as you do not exceed the pesticide rate recommended on the label. Be sure to check the label for any restrictions about crop rotation, days to harvest, or surplus spray mix disposal.

NEVER re-spray the treated field with undiluted spray mix. Spraying an area twice will double the recommended pesticide rate. This may cause illegal pesticide residues in the harvested crop or harmful residues in the soil that can cause crop damage.

Soluble Packaging Options

Choose soluble packages that dissolve in the spray tank to reduce container disposal. Water-soluble packaging is used for dry flowable and wettable powder formulations of pesticides and is available under names such as Clean Pak, Solupak, and Toss-N-Go. In most cases, the water-soluble packaging material is PVA (poly vinyl alcohol). This material dissolves completely when added to the water in the sprayer tank according to instructions.

Read all labels and instructions carefully. For more details contact your vendor.

Keep soluble pouches dry until you add them to the spray tank:

- Do not handle pouches with wet hands or wet gloves.
- Do not remove pouches from the outer package until you are ready to add them
- Always reseal the outer package to protect the remaining pouches from moisture.

Mixing Soluble Pouches

- Consult product labels for specific mixing instructions for each product.
- Fill the spray tank ¼ full of water and have the agitator running – then add the water-soluble pouches to the tank.
- Most pouches dissolve completely within 5 minutes, depending on the water temperature and the degree of agitation
- As the tank continues to fill, add any other compatible pesticides.
- **Do not add:**
  - a pesticide that is incompatible with the PVA packaging material. The PVA material is not soluble with summer-type oils (e.g., Superior Oil).
  - any material containing boron (e.g., Solubor), chelated micronutrients or water-soluble fertilizers. This combination is likely to cause a sticky, insoluble substance in the tank. If you apply boron, chelated micronutrients or water-soluble fertilizers, make sure that you completely empty and rinse the spray tank before you use any product packaged in PVA.

Storing Pesticides

Ontario's *Pesticides Act* and Regulation 914 gives storage requirements for storage facilities. The storage requirements that you must follow depend on which Schedules of pesticides that you store.

Pesticides Act Storage Requirements

	Sch. 3, 4 & 6	Sch. 2	Sch. 1 & 5
[illegible]	♦	♦	♦
Not Impair Health/Safety	♦	♦	♦
[illegible]	♦	♦	♦
Warning Signs Posted on Storage Buildings	♦	♦	♦
[illegible]	♦	♦	♦
Emergency Telephone Numbers Posted	♦	♦	♦
[illegible]		♦	♦
Limited Access (Locked)		♦	♦
[illegible]		♦	♦
Safety Equipment Available		♦	♦
[illegible]			♦

See also OMAFRA Factsheet, *Pesticide Handling Facilities*, Order No. 94-037.

Pesticide Spills

Protect yourself before you begin to clean up any spill. Clean up spills immediately.

In the case of minor spills:

- for liquids, cover the spill with a thick layer of absorbent material such as kitty litter, vermiculite or dry soil. Sweep or shovel the material into a waste drum
- for powders and granulars, sweep or shovel the material into a waste drum.

In the case of a major spill:

- remove any people or animals from the spill area
- stop the spill from spreading
- do not let the pesticide enter any watercourse.

For information on preventing spills see OMAFRA Factsheet, *Ways to Avoid Pesticide Spills*, Order No. 96-025. (See inside front cover for information on how to obtain Factsheets.)

If a well becomes contaminated, follow the clean-up instructions in OMAFRA Factsheet, *Pesticide Contamination of Farm Water Supplies*, Order No 00-099.

Application Procedures

Sprayers

- Sprayers that can deliver enough litres per hectare for adequate coverage are satisfactory for applying emulsion-type insecticides.
- If 2,4-D or related herbicides are used, clean the sprayers thoroughly with detergent containing ammonia to prevent crop damage.
- Adequate agitation is essential when applying wettable powder formulations. .
- Pumps should be capable of delivering the flow and pressure required as well as being compatible with materials sprayed.
- Keep in mind that the higher the pressure, the greater the danger of drift to other crops.
- Calibrate your sprayer at least twice during the growing season with each set of nozzles used. The wear on nozzles and other parts will alter the amount of spray delivered.
- Check all nozzles for flow rate at least once a year. Replace nozzles when their output is 10% greater than rated output.
- For information on calibration, see Chapter 2. See calibration calculator on the OMAFRA Web site www.gov.on.ca/OMAFRA/english/crops/sprayer/ep75.htm.

General Precautions and Requirements for Fumigants (Gases, Vapours and Fumes/Smokes)

Read and follow all instructions on the product label regarding protective clothing and equipment, aeration of treated areas, and re-entry periods.

- Lock the building and post warning signs.
- **If you use a fumigant gas** such as methyl bromide plus chloropicrin or aluminum phosphide to fumigate a structure you must hold the appropriate license **and** obtain a permit issued under Ontario's *Pesticides Act*. To apply for a permit, contact the regional pesticides officer with the Ontario Ministry of the Environment
- As a safety precaution, have someone else who is wearing personal protective equipment help with the fumigation. (This is a requirement for all fumigant gas use.)
- **When you handle methyl bromide**, do not wear gloves. You must wear a self-contained positive pressure breathing apparatus.
- **When you handle aluminum phosphide**, use cotton gloves and wear a full-face mask respirator with an acid gas canister, or a self-contained positive-pressure breathing apparatus.

For more information, obtain *Structural Fumigation Procedures (September 1998 edition)* from the Ontario Ministry of the Environment.

Band Spraying

Check the product label under Directions for Use. Some labels give specific nozzle recommendations and formulas to determine band application rates.

You need to decide how much spray mix to prepare so that you will apply the recommended rate over the band area. To know how much to mix, you will first need to calculate the size of the entire treated area.

To calculate the total area of all the treated bands:

Total Area of Bands (ha or acres) =

Total area of the planted field (ha or acres) x $\frac{\text{band width (cm or in)}}{\text{row spacing (cm or in)}}$

Seed Treatments

Remember that seed treatment products are also pesticides.

- Seed dressings and seed treatments are poisonous to people and animals.
- Wear protective clothing and equipment when you are treating seed, or handling treated seed. Protect your skin – wear a long-sleeved shirt and long pants or coveralls and wear neoprene or nitrile gloves. Protect your eyes with goggles and/or a face shield. Wear a respirator to protect your lungs from dusts and vapours.
- Wash thoroughly after finishing the treatment, or handling the treated seed.

- Never feed treated seed to animals
- Keep treated seed out of the reach of children.
- Destroy all the bags that have held treated seed as recommended in the container disposal section by burning or by taking to a licensed waste disposal site.

Aerial Application by Airplane or Helicopter

Any person who applies pesticide from an aircraft in Ontario **must** hold an aerial exterminator licence. In addition, a permit is required to purchase and apply pesticides by air for the following:

- applications to surface water, e.g. ponds, lakes, rivers (exceptions in some cases)
- applications to forests as defined in the *Crown Forest Sustainability Act*
- applications of any Schedule 1 or 5 pesticide or a Schedule 2 pesticide containing 2,4-D, 2,4-DB, mecoprop, MCPA, MCPB, dichlorprop, dicamba, picloram, paraquat or trichlopyr except when applications are made to agricultural land.

Be sure that any pesticide you apply by air has specific instructions for aerial use on the label.

Take extra precautions when using insecticides applied by air that are toxic to honeybees.

CHAPTER 4. NOTES ON HERBICIDES

Introduction

These notes should be considered with the recommendations given later in this publication. Additional information on use, toxicity and safety precautions is given here. With a few exceptions the herbicides are listed under their common (generic) rather than their trade or product name. See *Table 1* to determine the corresponding common name for a particular trade name. For example, *Table 1* indicates that the trade name AATREX has a common name of atrazine; notes on AATREX will be listed under atrazine in this section. See Chapter 5, *Notes on Adjuvants*, for information on adjuvants.

Complete information on each herbicide is available on the product label which is located on the herbicide container. The federal Pest Management Regulatory Agency also lists pesticide labels on their internet website at http://64.26.129.82/search/queryhit.htm. Many herbicide manufacturers also list product labels and/or Material Safety Data Sheets (MSDS) on their websites that are listed on the last page of this publication.

2,4-D

Trade Names: 2,4-D AMINE, ESTEMINE (AMINE), ESTASOL (L.V.ESTER), IPCO 2,4-D AMINE 600 SAVAGE. **Chemical Family:** Phenoxy. **Crop and/or Non-Crop Registrations**: Cereals, turf, pastures, non-crop land, asparagus, field corn, cranberries, raspberries, strawberries, bearing fruit trees including apple, pear, peach, plum, apricot and cherries, water weeds and brush. **Sensitive Weeds:** Most broadleaf weeds, and brush. **Uptake and Translocation:** Readily absorbed through leaves or roots. Translocated primarily in phloem with the sugars but can also move with water in the xylem. Accumulation is primarily in the young, rapidly growing meristematic regions of roots or shoots. **Basis of Selectivity:** Differences in interception, penetration, translocation, metabolism and sensitivity of active sites lead to greater activity on broadleaf weeds compared to grasses. **Application Methods:** Postemergence (broadleaf weeds), stem-foliage or stem-basal (brush). **Residual Activity:** Half-life in soil is usually not longer than 1 or 2 weeks during the growing season due to rapid decomposition by soil micro-organisms. **Unique Characteristics:** All weeds are more easily killed when growing rapidly in moist soil. Unfortunately,some broadleaf crops, garden and ornamental plants are as sensitive to 2,4-D as many weeds and only a trace of the chemical as spray drift, vapour drift or contaminant in soil or water may cause serious damage. Even crops that can be sprayed safely can be sensitive at some stages of growth or at excessive application rates; thus label precautions should be followed carefully. Amines and esters are the most common formulations of 2,4-D. The esters are the most active and can be used at the lower rates and for brush control. Since vapour drift is a potential problem with the ester formulations, only the amines should be used on lawns, or near gardens or susceptible crop areas. Low-volatile esters can be used by agriculturists or licenced applicators in areas where risk of damage to sensitive non-target vegetation is low. Recommendations are on the basis of acid equivalent; commercial products differ in their content of acid equivalent, which must be considered in determining the amount of product to use.

2,4-D/DICAMBA/MECOPROP

Trade Names: KILLEX, KILLEX SUMMER FORMULA, KILLEX 500, KILMOR, PAR III, PREMIUM 3 WAY. **Chemical Family:** Phenoxy/benzoic acid/phenoxy. **Crop and/or Non-Crop Registrations:** KILMOR for spring wheat, winter wheat, barley, corn, oats, non-crop land; KILLEX, TRICEP and PREMIUM 3-WAY TURF HERBICIDE (turf only) and PAR III for turf. **Sensitive Weeds:** At field-crop rates: wild buckwheat, lady's-thumb, green smartweed, Russian thistle, sow-thistle, hedge bindweed, corn spurry, knotweed, volunteer cultivated buckwheat, common ragweed, cocklebur, stinkweed, mustards, prostrate pigweed, redroot pigweed and lamb's-quarters. At non-crop-land rates, a wide range of broadleaf weeds including bull thistle, chicory, goat's beard, ragwort, white cockle, poison-ivy, alder and sheep-laurel. **Application Method:** Postemergence when weeds are small and actively growing; see crop recommendations for specific timing. **Unique Characteristics:** This mixture controls a wider spectrum of weeds than any of the herbicides alone.

2,4-DB

Trade Names: COBUTOX, EMBUTOX 625, CALIBER 400. **Chemical Family:** Phenoxy. **Crop and/or Non-Crop Registrations:** Seedling alfalfa, bird's-foot trefoil, clovers (except sweet) direct seeded or underseeded in spring wheat, barley or oats; corn. **Sensitive Weeds:** Many small broadleaf weeds such as stinkweed, ragweed, lamb's-quarters, wild buckwheat and mustards. Top-growth control of Canada thistle, field bindweed and perennial sow-thistle. **Uptake and Translocation:** Absorbed through the foliage and readily translocated to the growing points. **Basis of Selectivity:** Sensitive weeds rapidly convert 2,4-DB into 2,4-D; tolerant species do not make this conversion under normal conditions. **Application Method:** Post-emergence. **Residual Activity:** None. **Unique Characteristics:** Mustards are not usually controlled by 2,4-DB alone if sprayed beyond the 4-leaf stage; a tank-mixture with MCPA will improve control of these larger mustards. Injury to alfalfa increases under drought stress, or when alfalfa seedlings have more than 4 leaves.

ACIFLUORFEN

Trade Name: BLAZER. **Chemical Family:** Diphenyl ether. **Crop and/or Non-Crop Registrations:** Soybeans. **Sensitive Weeds:** Annual broadleaf weeds including: cocklebur, jimsonweed, lady's-thumb, lamb's-quarters, wild mustard, redroot pigweed, common ragweed and eastern black nightshade. Suppression of perennial weeds including: Canada thistle, hedge bindweed, field bindweed and common milkweed. **Uptake and Translocation:** Taken up through the foliage. Not readily translocated. **Basis of Selectivity:** Metabolism by tolerant species. **Application Methods:** Postemergence when weeds are small and actively growing. Apply in 200–400 L/ha of water with a pressure of 275–400 kPa. Soybeans are tolerant after the first trifoliate-leaf stage. Thorough coverage is necessary. The use of flat fan nozzles is recommended. **DO NOT** add adjuvants to acifluorfen applied at the full rate. BASAGRAN may be tank-mixed with acifluorfen for control of additional broadleaf weeds including velvetleaf. When tank-mixing BASAGRAN and acifluorfen the addition of 1 L/ha of ASSIST OIL CONCENTRATE is recommended. **Residual Activity:** Essentially none. **Unique Characteristics:** Acifluorfen is not volatile. Significant crop injury can be expected if acifluorfen is applied during hot, humid weather or if the crop is stressed due to previous herbicide injury, flooding, drought or cold conditions prior to the application. Cool weather or drought may delay control. Rainfall within 6 hr. after application may reduce effectiveness. Since there is no residual activity, a new flush of weeds may emerge after the first flush has been controlled.

ADJUVANT

See Chapter 5, *Notes on Adjuvants*.

AMITROLE

Trade Name: AMITROLE 240. **Chemical Family:** Triazole. **Crop and/or Non-Crop Registrations:** Preplant in wheat, barley, canola, field peas, corn, soybeans and white beans. Postharvest after any crop. In-season weed control in apples. Use in shelterbelts, non-crop areas, marshes and ditches. Spot treatment in pastures. **Sensitive Weeds:** Many annual and perennial broadleaf weeds and grasses including quack grass, dandelions, Canada thistle, sow-thistle, poison-ivy, poison-oak, toadflax, milkweed, hoary cress, leafy spurge, horsetail, cattail, honeysuckle, locust, ash and sumac. **Uptake and Translocation:** Absorbed by foliage and roots. Translocates well in xylem and phloem. Accumulates in growing regions of plant. **Basis of Selectivity:** Resistant plants metabolize amitrole more rapidly than sensitive plants and may have lower uptake as a result of leaf structure that reduces wetting and penetration. **Application Methods:** Foliar postemergence application to actively growing plants. Good coverage is essential. If weeds are mature, it is advisable to cut them and then spray the regrowth. Do not disturb treated plants for at least 2 weeks after application. Do not make postharvest application after October 1. For control of quack grass and Canada thistle, apply in spring or fall to actively growing plants 15–20 cm tall: wait 10–14 days and then plough or disk. **Residual Activity:** Approximately 2–4 weeks in moist, warm soil. **Unique Characteristics:** Most crops are sensitive if contacted. Poor results may occur if spray coverage is inadequate, if plants are drought stressed or overmature, or if heavy rains fall within 6 hr. after application. Do not graze or plant to grain, peas, alfalfa or clover for 8 months after treatment. Do not graze spot-treated areas in pastures for 6 months following treatment.

ATRAZINE

Trade Names: AATREX, AATREX NINE-O, ATRAZINE 90W, ATRAZINE 80W, ATRAZINE 500, ATRAZINE 480, CONVERGE 480. **Chemical Family:** S-triazine. **Crop and/or Non-Crop Registrations:** Corn (ensilage, field, seed and sweet), lowbush blueberries and triazine-tolerant canola (rapeseed). **Sensitive Weeds:** Will control a wide range of broadleaf weeds such as mustards, purslane, ragweed, smartweed, lady's-thumb, wild buckwheat, lamb's-quarters, pigweed and volunteer clover. Populations of lamb's-quarters, pigweed and ragweed have been found that are resistant to atrazine and are therefore not controlled. **Uptake and Translocation:** Actively absorbed by roots and foliage, although foliar absorption is usually small. It is translocated to the top of the plant and accumulates in the leaf margins and the growing points. **Basis of Selectivity:** Metabolism by tolerant species. Spray timing avoids contact with lowbush blueberries to prevent injury. **Application Methods:** For corn, preplant incorporated, preemergence, or postemergence (with or without oil) usually before the annual weeds are more than 4 cm high; under dry weather conditions a shallow incorporation may enhance activity; oil or oil/surfactant blends will increase the postemergence activity. For lowbush blueberries, preemergence application. For triazine-tolerant canola, postemergence. Dry bulk fertilizer may be impregnated with atrazine and applied preplant incorporated. Atrazine may be tank-mixed with several other annual grass and broadleaf herbicides to increase the spectrum of weed control in corn. **Residual Activity:** Can persist in the soil for varying lengths of time depending on rate, weather and soil conditions (longer under dry, cool weather conditions and in sandy soils). Postemergence treatments tend to persist longer than preemergence treatments. See section "Special Notes for CORN". **Unique Characteristics:** Atrazine may carry over for more than 1 planting season. One year after application there is usually no hazard to most rotational crops when 1.5 kg ai/ha or less is applied. Cool, dry weather and sandy soils are conditions under which problems may arise. See "Notes on atrazine and simazine soil residues" in "Special Notes for CORN".

ATRAZINE/2,4-D

Trade Name: SHOTGUN. **Chemical Family:** Triazine/phenoxy. **Crop and/or Non-Crop Registrations:** Field corn. **Sensitive Weeds:** Lady's-thumb, lamb's-quarters, wild mustard, redroot pigweed, common ragweed, velvetleaf, wild buckwheat; tankmix with pendamethalin+rimsulfuron, nicosulfuron, rimsulfuron or nicosulfuron/rimsulfuron for control of

barnyard grass, green foxtail and yellow foxtail; tankmix with rimsulfuron or nicosulfuron/rimsulfuron for control of fall panicum. **Uptake and Translocation:** Both components may be taken by either roots or shoots, but the atrazine will primarily be absorbed by the roots and travel in the transpiration stream, while the 2,4-D will primarily be absorbed by the shoots and move in the phloem. **Basis of Selectivity:** See notes on 2,4-D and atrazine. **Application Method:** Postemergence. **Residual Activity:** Injury may occur if land treated with atrazine/2,4-D is planted to any crop other than corn in the same season. Sensitive crops such as tobacco and sugar beets should not be planted in the year following treatment. When extended periods of dry weather occur during the year of treatment, there can be some injury to succeeding crops such as white beans, onions, peas, tomatoes and turnips. Injury is most likely to occur when the seedling crop is subjected to periods of stress, e.g., during periods of abnormally hot, dry weather. **Unique Characteristics:** See the 2,4-D note for information about spray and vapour drift. See also "Notes on atrazine and simazine soil residues" in "Special notes for CORN".

BENSULIDE

Trade Name: BETASAN. **Chemical Family:** Benzenesulfonamide. **Crop and/or Non-Crop Registrations:** Lawns, turf and cucumbers. **Sensitive Weeds:** Germinating annual grasses such as annual bluegrass, barnyard grass, crab grass and foxtail. Some control of redroot pigweed, lamb's-quarters and shepherd's-purse. **Uptake and Translocation:** Adsorbed on root surfaces and a small amount is absorbed by the roots. Little or none is translocated upward to the leaves. **Basis of Selectivity:** Inhibits root growth and partially inhibits cell division in sensitive seedlings. Sensitive species affected only in seedling stage. Metabolized by established grasses. **Application Methods:** Preemergence in spring or fall for turf (well-established only); a higher rate is required for fall applications to control germinating weeds the following spring; incorporate by lightly irrigating into soil. **Residual Activity:** Season-long weed control. Degraded slowly by soil micro-organisms with a half-life of 4–6 months depending on soil type. Because of soil residues, only cucurbits, cole crops, carrots, lettuce, peppers and tomatoes should be planted the following year. **Unique Characteristics:** Bensulide is inactivated in soils containing high amounts of organic matter (muck soils). Incorporation recommended to avoid photodecomposition. Do not reseed lawn within 1 year of application. Formulations available with fertilizers for homeowner lawn use.

BENTAZON

Trade Names: BASAGRAN FORTE, BASAGRAN. **Chemical Family:** Benzothiadiazine. **Crop and/or Non-Crop Registrations:** BASAGRAN FORTE AND BASAGRAN: Peas, flax, soybeans, dry beans, faba beans, corn. BASAGRAN also registered for peanuts, lima beans, snap beans, highbush blueberry, new plantings of apples, apricots, cherries, peaches, pears and turf. **Sensitive Weeds:** Annual broadleaf weeds including hairy nightshade, lamb's-quarters, redroot pigweed, low cudweed, purslane, common ragweed, wild radish, Russian thistle, hairy galinsoga, corn spurry, bird rape, flower-of-an-hour, buttercups, common groundsel, jimsonweed, giant ragweed, velvetleaf, lady's-thumb, wild mustard, cocklebur, stinkweed, shepherd's-purse and common chickweed. Triazine-tolerant biotypes of lamb's-quarters, redroot pigweed, common ragweed and common groundsel are also controlled. Top growth of Canada thistle and nut sedge are controlled. Field bindweed may be suppressed by 2 applications applied 10 days apart. **Uptake and Translocation:** Taken up through the foliage. Not translocated. **Basis of Selectivity:** Metabolism by tolerant species. **Application Methods:** Postemergence when weeds are small and actively growing. Apply in 100–400 L water/ha. Crop must be in a tolerant growth stage (see specific recommendations on label). Thorough spray coverage is necessary. Use flat fan nozzles tilted 45° forward. Use ASSIST OIL CONCENTRATE with BASAGRAN. The ASSIST rate should be reduced under hot, humid conditions. CITOWETT PLUS may replace ASSIST on peas. Liquid ammonium sulphate or 28% urea ammonium nitrate may be added to BASAGRAN FORTE or BASAGRAN for improved and more consistent control of velvetleaf and lamb's-quarters in soybeans only. PINNACLE may be tank-mixed with BASAGRAN FORTE or BASAGRAN for improved pigweed and lamb's-quarters control in soybeans only. BASAGRAN FORTE does not require additional adjuvants. BASAGRAN FORTE is not registered for aerial application. BASAGRAN is registered for aircraft application for soybeans, dry and snap beans. **Residual Activity:** Essentially none. **Unique Characteristics:** Corn and turf are tolerant at all stages of growth. Bentazon is not volatile. Temporary crop injury can be expected if bentazon is applied during hot, humid weather or if crop is stressed (flooding, drought, cold). Cool weather or drought may delay control. Rainfall within 6–8 hr. after application may reduce effectiveness. Since there is no residual activity, a new flush of weeds may emerge after the first flush has been controlled.

BENTAZON/ATRAZINE

Trade Name: LADDOK. **Chemical Family:** Benzothiadiazine/s-triazine. **Crop and/or Non-Crop Registrations:** Corn (ensilage, field, seed and sweet). **Sensitive Weeds:** Annual broadleaf weeds such as black nightshade, redroot pigweed, lamb's-quarters, low cudweed, purslane, common ragweed, Russian thistle, corn spurry, flower-of-an-hour, lady's-thumb, wild mustard, hairy galinsoga, bird rape, buttercup, common chickweed, common groundsel, jimsonweed, giant ragweed, velvetleaf and cocklebur. Triazine-tolerant biotypes are also controlled. Top growth of Canada thistle and nut sedge are controlled. Field bindweed may be suppressed. **Uptake and Translocation:** Uptake into the plant occurs primarily through the leaves. Bentazon/atrazine has mainly contact action and translocation is minimal. **Basis of Selectivity:** Metabolism by tolerant species. **Application Methods:** Bentazon/atrazine should be applied early postemergence when weeds are small and actively

growing. Apply in 200–400 L water/ha. Application should be made before weeds reach the maximum size listed on the label. This generally corresponds to corn in the 1 to 5–leaf stage. Under good growing conditions, the most effective time for spraying will usually be 18–28 days after planting. ASSIST OIL CONCENTRATE should be added to the spray tank for all applications. Thorough spray coverage is important and flat fan nozzles should be used. The use of flooding nozzles is not recommended because of inadequate coverage. **Residual Activity:** Injury may occur to any crop other than corn planted in the same season on land treated with bentazon/atrazine. In the season after application, there is virtually no hazard to most rotational crops when label rates for annual weed control have been used. Overlap or the use of a double application for nut sedge control may result in injury to rotational crops due to carry over of the atrazine component of bentazon/atrazine. **Unique Characteristics:** Corn is tolerant at all stages of growth. Rainfall within 6–8 hr. of application may reduce effectiveness of the spray solution. Bentazon/atrazine is not volatile but it should not be applied when crop is under stress from prolonged cold, wet weather, poor fertility or other factors.

BROMACIL

Trade Names: HYVAR X-L. **Chemical Family:** Uracil. **Crop and/or Non-Crop Registrations:** Non-crop land for total vegetation control and as a spot treatment to control brush. **Sensitive Weeds:** Annual and perennial broadleaf weeds and grasses (broadcast application). Several brush species (spot application). **Uptake and Translocation:** Most readily absorbed through the roots. Surfactants can enhance foliar activity. Translocation is upward with the movement of water to leaves where it inhibits photosynthesis. **Basis of Selectivity:** Non-selective at normal rates. **Application Methods:** For herbaceous weeds, broadcast sprayed, preferably just before or during periods of active weed growth. For brush, spot applications with an exact-delivery handgun sprayer either at the base of target brush or on a grid. **Residual Activity:** Half-life was 5–6 months for 4.4 kg/ha bromacil in a silty loam soil. **Unique Characteristics:** Bromacil should not be used where it is likely to leach, wash or move with eroded soil into contact with the roots of desirable trees and shrubs. Do not apply to brush standing in water.

BROMACIL/DIURON

Trade Name: KROVAR. **Chemical Family:** Uracil/substituted urea. **Crop and/or Non-Crop Registrations:** Non-crop land. **Sensitive Weeds:** Most herbaceous weeds. **Basis of Selectivity:** Non-selective. **Application Method:** Broadcast sprayed just before or during the period of active weed growth. **Unique Characteristics:** Normally fewer species of weeds escape or regrow after use of this mixture compared to use of the same amount of either chemical alone. Also see notes on BROMACIL and DIURON.

BROMOXYNIL

Trade Name: PARDNER, KORIL. **Chemical Family:** Hydroxybenzonitrile. **Crop and/or Non-Crop Registrations:** Spring wheat, barley, oats, corn, fall rye, triticale, forage sorghum and millet, and many other grasses, garlic **Sensitive Weeds:** Smartweed, nightshade, velvetleaf, pigweed, common ragweed, cocklebur, stinkweed, and wild mustard are killed if the chemical thoroughly contacts these plants before they have more than 4 true leaves: wild buckwheat and lamb's-quarters control to 8 leaf. Most established perennial broadleaf weeds, chickweed and grasses tolerate field applications of this herbicide. **Uptake and Translocation:** Absorbed by plant foliage and moves very little within the plant. **Basis of Selectivity:** Differential spray retention, uptake, translocation and degradation. **Application Method:** Postemergence. **Residual Act-ivity:** Essentially no soil residual activity. **Unique Characteristics:** Crop injury symptoms (leaf scorch) may develop if the plant is under stress within 2 or 3 days before or after spraying; this stress could be caused by high temperatures or high humidity or, in the case of corn, application following a period of cool, wet weather; such injury usually does not affect yields. The formulation includes a wetting agent to improve the spread of droplets on the leaf. Although bromoxynil is not an effective soil-applied herbicide, broadleaf crops such as turnips, peas and beans should not be seeded for a week after spray application.

BROMOXYNIL/MCPA

Trade Names: BUCTRIL M, MEXTROL. **Chemical Family:** Hydroxybenzonitrile/phonoxy. **Crop and/or Non-Crop Registrations:** Spring and winter wheat, barley, oats, flax, fall rye, corn, timothy hay and canary grass. **Unique Characteristics:** Combination of bromoxynil with MCPA provides better control of mustards than bromoxynil alone. Also see notes on BROMOXYNIL and MCPA.

CHLORIMURON-ETHYL

TRADE NAME: CLASSIC. **CHEMICAL FAMILY:** Sulfonylurea. **CROP AND/OR NON-Crop Registrations:** Soybeans. **Sensitive Weeds**: Common ragweed, redroot pigweed, and velvetleaf. **Uptake and Translocation:** Following foliar application, chlorimuron is rapidly absorbed through the leaves and translocated in both xylem and phloem. **Basis of Selectivity:** Inhibition of acetolactate synthase (ALS) enzyme in susceptible plants leads to a rapid cessation of cell division and growth. Tolerant species rapidly convert chlorimuron to non-phytotoxic metabolites. **Application Methods:** Postemergence. **Residual Activity:** Chlorimuron will provide some limited residual activity after application.. **Unique Characteristics:** A non-ionic surfactant must be added at 0.2% v/v. 28% Urea ammonium nitrate (U.A.N.) at 2 L/ha will improve the control of velvetleaf. Typical symptoms of plant death (chlorosis, necrosis) may occur from 1–3 weeks after application, depending on growing conditions. Favourable growing conditions will speed the activity while cool or dry conditions will delay activity.

CHLORIMURON-ETHYL/ THIFENSULFURON-METHYL

Trade Name: RELIANCE STS. **Chemical Family:** Sulfonylurea. **Crop and/or Non Crop Registrations:** STS soybeans. **Sensitive Weeds:** common ragweed, redroot and green pigweed, velvetleaf, and lamb's-quarters. **Uptake and Translocation:** Following foliar application, the herbicide is rapidly absorbed and translocated in both the xylem and phloem to growing points of sensitive weeds. **Basis of Selectivity:** Inhibition of acetolactase synthase (ALS) enzyme in susceptible plants which leads to a rapid cessation of cell division and plant growth. Tolerant species rapidly metabolize the herbicide into non-phytotoxic metabolites. **Application Methods:** postemergence. **Residual Activity:** Some limited residual activity from the chlorimuron-ethyl component of the herbicide. **Unique Characteristics:** Must be applied with an approved adjuvant system including 0.2% v/v non-ionic surfactant. Addition of 28% urea ammonium nitrate (U.A.N.) at 2 L/ha will improve weed control. Plant death of target weeds may take from 1–3 weeks for visual symptoms to develop. Symptoms develop more quickly under favourable growing conditions.

CHLORPROPHAM

Trade Names: CIPC EC, CIPC GR, CIPC. **Chemical Family:** Phenylcarbamate. **Crop and/or Non-Crop Registrations:** Carrots, lettuce, onions, spinach, daffodils, gladioli, iris, tulips and ornamental nursery stock. **Sensitive Weeds:** Annual broadleaf and grass weeds including purslane, chickweed, smartweed, carpetweed, false flax, annual bluegrass, crab grass, rye grass, stink grass and dodder. **Uptake and Translocation:** Readily translocated to the leaves following root absorption. Vapours have been demonstrated to be absorbed by seeds and emerged dodder. **Basis of Selectivity:** Rapid degradation in tolerant plants as well as soil adsorption. **Application Methods:** Preemergence and directed postemergence in specified crops. **Residual Activity:** Tightly bound to soil colloids. The rate of dissipation can vary greatly with microbial activity and moisture level. Both high soil temperature and excessive soil moisture increase the rate of dissipation. **Unique Characteristics:** Use the lower rates on sandy or coarse-textured soils and the higher rates on clay or muck soils. Weed control is most effective when soil temperatures are below 16°C. The lower rate should be used when soil temperature is below 16°C. The soil must be moist for effective weed control.

CHLORSULFURON

Trade Name: TELAR. **Chemical Family:** Sulfonyl urea. **Crop and/or Non-Crop Registrations:** Non-crop land. **Sensitive Weeds:** Annual and perennial broadleaf weeds such as wild carrot, Canada thistle, sow-thistle, scentless chamomile, lamb's-quarters, wild mustard, redroot pigweed, stinkweed, cow cockle, chickweed and Russian thistle. **Uptake and Translocation:** Thoroughly systemic after absorption of either foliage or roots. Foliar absorption is rapid. **Basis of Selectivity:** A disruption of amino acid metabolism leads to an inhibition of cell division in sensitive plants. Faster rates of metabolic detoxification have been observed in tolerant species. **Application Methods:** Preemergence or early postemergence. **Residual Activity:** Half-life is 4–6 weeks under growing season conditions. Degradation is faster with higher soil temperatures and/or lower soil pH. **Unique Characteristics:** Although degradation is moderately rapid, extremely low residues can be highly toxic to some broadleaf weeds, such as wild carrot, for up to 2 years after application. Use of this product requires a surfactant.

CLETHODIM

Trade Name: SELECT. **Chemical Family:** Cyclohexanedione. **Crop and/or Non-Crop Registrations:** Canola, flax, soybeans, sunflowers, dry onions, and potatoes . **Sensitive Weeds:** Annual grasses (wild oats, green and yellow foxtail, volunteer cereals, volunteer corn and barnyard grass). **Uptake and Translocation:** Uptake through the foliage and translocated through both the phloem and xylem throughout the plant accumulating in the meristemic regions both above and below the ground. **Basis of Selectivity:** Tolerant plants rapidly metabolize clethodim to several conjugated metabolites. **Application Method:** Postemergent to actively growing grasses in the 2–6 true-leaf stage. **Residual Activity:** Rapid degradation in both soil and water with no soil activity. **Unique Characteristics:** Highly active on all annual grasses and volunteer cereals at one low dose rate of 0.19 L/ha in a tank-mix with the adjuvant CC-16255.

CLOPYRALID

Trade Names:, LONTREL 360, TRANSLINE. **Chemical Family:** Pyridine. **Crop and/or Non-Crop Registrations:** Strawberries, highbush blueberries, new and bearing apples, cranberries, sugar beets, rutabagas, cole crops (cabbage, cauliflower, broccoli, asian cole crops), canola, barley, oats, wheat, control of broadleaf weeds in rights-of-way (hydro, railroad, communication lines, pipelines) and associated stations, industrial manufacturing sites, storage sites and roadsides, airports, military bases and low maintenance, rough-turf areas, rangeland, grass pasture and balsam fir Christmas tree stands or plantations. **Sensitive Weeds:** Will control or suppress certain annual and perennial weeds including Canada thistle, goldenrod, ox-eye daisy, tufted vetch, sheep sorrel, dandelion and wild buckwheat, scentless chamomile, groundsel, ragweed, coltsfoot and spotted knapweed. **Uptake and Translocation:** Rapidly absorbed by foliage and translocated readily throughout the plant via both xylem and phloem systems. Clopyralid is distributed throughout the plant to the meristem. **Basis of Selectivity:** Effects on nucleic acid metabolism and growth are not observed in grasses and other tolerant species. **Application Methods:** Postemergence as a broadcast or selective foliar. **Residual Activity:** Half-life in soil is less than 30 days under conditions that are favourable for microbial degradation. Little to no residual activity. **Unique Characteristics:** Clopyralid has little to no activity on woody vegetation, except woody species of the legume family.

CLORANSULAM-METHYL

Trade Name: FIRSTRATE. **Chemical Family:** Triazolopyrimidine sulfonanilide. **Crop and/or Non-Crop Registrations**: Soybeans. **Sensitive Weeds:** Common ragweed, giant ragweed, cocklebur, velvetleaf, and jimsonweed. **Uptake and Translocation:** Absorption by roots, shoots and foliage. Translocation via the xylem and phloem and accumulation in the growing points. **Basis of Selectivity:** Metabolism by soybeans. Inhibition of the acetolactase synthase (ALS) enzyme in susceptible plants followed by a rapid cessation of cell division and plant growth. **Application Methods**: Preemergence in both conventional and conservation tillage systems or postemergence prior to the flowering stage of soybeans. **Residual Activity:** Decomposition in soils is attributed primarily to microbial degradation. Some rotational cropping restrictions apply. Refer to *Table 2* for additional information. **Unique Characteristics:** Do not apply to peat or muck soils. Preemergence or postemergence applications require an activating rainfall that moistens the soil to a depth of at least 5 cm in order to move FirstRate into the weed germination zone. If adequate rainfall is not received within 7–10 days after application, a shallow cultivation or use of a rotary hoe is recommended. Do not apply when air temperature is near freezing or when freezing conditions are expected for several days following time of application. Extended cold, wet conditions or abnormally high soil moisture conditions during emergence and early crop development may cause injury symptoms on soybeans such as temporary yellowing of the leaves and/or crop stunting. Soybeans will quickly outgrow these symptoms once normal growing conditions resume. Postemergence application prior to full emergence of the first trifoliate leaf may cause temporary yellowing of soybeans. This effect is transient and has no effect on soybean yields. Postemergence application requires the addition of a non-ionic surfactant (Agral 90) and a liquid ammonium fertilizer (28-0-0 or 32-0-0). See label for details.

COPPER ETHANOLAMINE

Trade Name: CUTRINE-PLUS. **Chemical Family:** Mixture of chelates of copper ethanolamines. **Crop and/or Non-Crop Registrations:** Algae control in wholly enclosed farm, fish and fire ponds and fish hatcheries having no outflow beyond the property limits of the user. **Sensitive Weeds:** Microcystis, Oscillatoria, Anabaena, Aphanizomenon, Spirogyra, Cladophora, Vaucheria, Ulothrix, Chara and Nitella. **Uptake and Translocation:** No information available. **Basis of Selectivity:** Non-selective. **Application Methods:** Available as a granular or liquid formulation. Apply early in the day as ample sunlight is required for maximum control. To ensure even distribution of the granular formulation, employ a scoop or dry fertilizer spreader. Use a hand or power sprayer for best distribution of the liquid formulation. To avoid oxygen depletion, treat only 1/3–1/2 of the pond at a time. Allow 1–2 weeks between treatments. **Residual Activity:** One application of granular CUTRINE-PLUS should provide control over the entire season. When using liquid CUTRINE-PLUS, a second treatment later in the season may be required. **Unique Characteristics:** Not for use in potable waters. Not for use in public waters or waters that drain into public waters. Extremely toxic to fish in soft waters; toxic in hard waters if the maximum recommended concentration is exceeded; if fish are present but water hardness is not known, do not use CUTRINE-PLUS. Treated areas may be used for swimming or fishing immediately after treatment. Water from treated pools may be used to irrigate turf, fairways, putting greens and ornamental plants.

CYANAZINE

Trade Names: BLADEX LIQUID, BLADEX 90DF. **Chemical Family:** S-triazine. **Crop and/or Non-Crop Registrations:** Corn (ensilage, field and sweet), triazine-tolerant canola (rapeseed). **Sensitive Weeds:** Annual nightshades, purslane, lady's-thumb, lamb's-quarters, prostrate knotweed, shepherd's-purse, wild buckwheat, wild mustard, wormseed mustard, velvetleaf, pigweed, crab grass, green foxtail, yellow foxtail, witch grass, fall panicum and barnyard grass. **Uptake and Translocation:** Readily absorbed by roots and foliage. When absorbed by roots it is translocated to the leaves. **Basis of Selectivity:** Metabolism by tolerant crops. **Application Methods:** Preplant incorporated in corn but only in mixtures with other corn herbicides; incorporation equipment should be set to work no deeper than 10 cm. Preemergence in corn; moisture is required for activation. Early postemergence in corn up to the 3–leaf stage (wettable granule). Early postemergence in triazine-tolerant canola (liquid formulation). **Residual Activity:** Cyanazine has a relatively short residual life in the soil; from normal spring applications there is no carryover of the herbicide to the next growing season. **Unique Characteristics:** Cyanazine is a short-lived triazine herbicide with flexible application time. Preemergence applications do not adequately control barnyard grass, fall panicum or pigweed under conditions that delay germination, such as low temperature or dry soil surface. Emerged velvetleaf will be controlled by the early postemergence application but subsequent germinating velvetleaf will not be controlled. Cynazine is not recommended alone for use on heavy clay soil. Do not use on peat, muck soils, sandy soils or soils with less than 1% organic matter. Do not use the liquid formulation postemergence in corn. Do not add oil or surfactants other than as specified on the label. Cyanazine may be used in tank-mixes and has been formulated with various other herbicides. See label for specifications.

CYCLOATE

Trade Name: RO-NEET. **Chemical Family:** Thiocarbamate. **Crop and/or Non-Crop Registrations:** Red beets, spinach. **Sensitive Weeds:** Crab grasses, barnyard grass, foxtails, yellow nut sedge and some annual broadleaf weeds. **Uptake and Translocation:** Uptake by seed, roots and

hypocotyl with upward translocation to the growing tip. **Basis of Selectivity:** Species differentiation due to enzymatic detoxification and seed food reserves permitting seedling to outgrow effect of chemical. **Application Methods:** Preplant incorporated. To prevent chemical loss, incorporate immediately into the soil by setting the incorporation equipment (i.e., tandem disks, field cultivator with sweep teeth, or vibrating shank S-tine cultivator) to work the soil approximately 10 cm deep followed by a levelling device. Irrigation (approximately 0.6 cm) can also be used to incorporate. When application and incorporation are done in separate operations, application should be to a dry soil surface. **Residual Activity:** Season-long weed control with no soil residues the following year to prevent crop rotation. **Unique Characteristics:** Does not need rainfall to activate and will not leach significantly under heavy rainfall. Under unfavourable germination conditions, leaf crinkling or leaf sealing may be observed, but usually without adverse effects on crop yield.

DAZOMET

Trade Name: BASAMID. **Chemical Family:** Dithiocarbamate. **Crop and/or Non-Crop Registrations:** Field and greenhouse vegetable seedbeds for eggplant, lettuce, pepper and tomato; fall treatment only of tobacco greenhouse seedbeds; field and greenhouse seed and planting beds for annual flowers; turf seedbeds. **Sensitive Weeds:** Most germinating weed seeds. **Uptake and Translocation:** Breaks down on contact with soil moisture and releases toxic gases that control germinating weed seeds. **Basis of Selectivity:** Non-selective. Chemical must be completely dissipated from the seedbed before planting or injury may occur. Breaks down on contact with soil moisture and releases toxic gases that control germinating weed seeds. **Application Methods:** Apply granular product to a well- worked seedbed and incorporate evenly. Seal soil immediately after incorporation by rolling and flooding or by covering with heavy polyethylene plastic and sealing edges. After a waiting period of 10–40 days, depending on soil temperature, aerate the soil. Conduct a safety germination test before using treated soil. Do not use when soil temperature is below 6°C. **Residual Activity:** Depends on the rate applied, soil moisture and soil temperature. The gases are toxic to all growing plants and a safety germination test must be carried out to determine that the soil is safe for planting. **Unique Characteristics:** Also controls unencysted nematodes and soil fungi.

DESMEDIPHAM

Trade Name: BETANEX. **Chemical Family:** Phenylcarbamate/Phenylcarbamate. **Crop and/or Non-Crop Registrations:** Sugar beets. **Sensitive Weeds:** Redroot pigweed, lamb's-quarters and wild mustard. Other weeds like ragweed species, wild buckwheat, nightshade species, kochia, goosefoot and stinkweed will be controlled when application of desmedipham is made following treatment with another preplant or preemergence herbicide. **Uptake and Translocation:** Desmedipham is readily absorbed by foliage where it inhibits photosynthesis in the chloroplasts of leaf cells. **Basis of Selectivity:** Rapid metabolism in tolerant species. **Application Methods:** Postemergence beginning at the 2 true-leaf stage of sugar beets. Up to the 2– or 4–leaf stage of weeds depending upon species. Best control is exhibited on very small, actively growing weeds. **Residual Activity:** Soil half-life of desmedipham is less than 1 month. **Unique Characteristics:** Desmedipham may cause temporary growth retardation and/or chlorosis or tip-burn to sugar beets when applied to stressed plants. Normal growth is resumed in 10 days after application.

DESMEDIPHAM/PHENMEDIPHAM

Trade Name: BETAMIX. **Chemical Family:** Phenylcarbamate. **Crop and/or Non-Crop Registrations:** Sugar beets. **Sensitive Weeds:** Pigweed species, lamb's-quarters, wild mustard, wild buckwheat, green and yellow foxtail. Other weeds like ragweed species, nightshade species, kochia, goosefoot and stinkweed will be controlled when application of desmedipham/phenmedipham is made following treatment with another preplant or preemergence herbicide. **Uptake and Translocation:** Desmedipham/ phenmedipham is readily absorbed by foliage where it inhibits photosynthesis in the chloroplasts of leaf cells. **Basis of Selectivity:** Rapid metabolism in tolerant species. **Application Methods:** Postemergence beginning at the 2 true-leaf stage of sugar beets. Up to the 2– or 4–leaf stage of weeds depending upon species. Best control is exhibited on very small, actively growing weeds. **Residual Activity:** Soil half-life of desmedipham is less than 1 month and of phenmedipham is 25–30 days. **Unique Characteristics:** Desmedipham/phenmedipham may cause temporary growth retardation and/or chlorosis or tip-burn to sugar beets when applied to stressed plants. Normal growth is resumed in 10 days after application.

DICAMBA

Trade Names: BANVEL II, VANQUISH. **Chemical Family:** Benzoic acid. **Crop and/or Non-Crop Registrations:** Field corn, spring and winter wheat, spring barley, spring rye, oats, summer fallow and stubble, pastures, red fescue, lowbush blueberries and turf; non-crop areas such as roadsides, utility rights-of-way and railways. **Sensitive Weeds:** Annual, perennial and biennial broadleaf weeds and numerous brush species including conifers. Particularly effective against velvetleaf, Canada thistle, field bindweed and various triazine-resistant broadleaf weeds. Control is best when weeds are small and actively growing. **Uptake and Translocation:** Readily absorbed by roots, stems or leaves and then translocated to other plant parts. **Basis of Selectivity:** Metabolism by tolerant species. **Application Methods:** Preemergence or postemergence in field corn. For all other crops and non-crop uses, postemergence applications are recommended. **Residual Activity:** Half-life in soil is approximately 30 days. Residue carryover into the next season is not a problem when applied at rates recommended for crop situations. **Unique Characteristics:** Dicamba is often mixed with grass herbicides or with phenoxy herbicides to

provide a broader spectrum of weed control. Spray drift is toxic to sensitive plants in the same manner as 2,4-D, thus similar precautions should be followed. Cold weather conditions and/or subsequent high rainfall after dicamba application may lead to temporary corn injury particularly on early-season hybrids in Eastern Ontario. There is also a possibility of dicamba vapour drift from treated plant foliage during high temperatures (in excess of 25°C). At higher rates, dicamba can be toxic to trees and shrubs having roots under the treated areas. See sections on Herbicide Drift and Reduction of Herbicide Drift.

DICAMBA/ATRAZINE

Trade Name: MARKSMAN. **Chemical Family:** Benzoic acid/s-triazine. **Crop and/or Non-Crop Registrations:** Field corn. **Sensitive Weeds:** Annual and biennial broadleaf weeds including the triazine-resistant biotypes. **Application Methods:** Postemergence until the standing height of the corn is 13 cm (5–leaf stage). **Unique Characteristics:** This mixture provides excellent control of triazine-resistant broadleaf weeds, maintains a low level of triazine for short-term residue and gives improved control of velvetleaf. Also see notes on dicamba and atrazine.

DICAMBA/MCPA

Trade Name: DYVEL. **Chemical Family:** Benzoic acid/phenoxy. **Crop and/or Non-Crop Registrations:** Barley, spring wheat, winter wheat and oats. **Unique Characteristics:** Provides better control of mustards and hemp-nettle than dicamba alone. Also see notes on dicamba and mcpa.

DICAMBA/MCPA/MECOPROP

Trade Name: TARGET, SWORD. **Chemical Family:** Benzoic acid/phenoxy/phenoxy. **Crop and/or Non-Crop Registrations:** Spring wheat, barley, oats not underseeded to legumes, stubble fields and summer fallow. **Sensitive Weeds:** At field-crop rates: wild buckwheat, cow cockle, lady's-thumb, green smartweed, mustards, hemp-nettle, Russian thistle, corn spurry, flixweed, annual sow-thistle, shepherd's-purse, common ragweed, pigweeds, chickweed, lamb's-quarters, knotweed, volunteer rapeseed and sunflowers. **Application Methods:** Postemergence when weed seedlings are in the 2– to 3–leaf stage, spring wheat and oats are in the 4– to 5–leaf stage and barley is in the 2– to 3–leaf stage. Use water carrier and apply at 100 L total spray mix/ha. **Unique Characteristics:** This mixture controls a wider spectrum of weeds than any of the herbicide components used alone. Under certain conditions, this mixture may cause shortening of the straw of cereals but yield will not be affected. See also dicamba, mecoprop and mcpa.

DICHLOBENIL

Trade Name: CASORON. **Chemical Family:** Benzonitrile. **Crop and/or Non-Crop Registrations:** Cranberries, fruit trees, grapes, highbush blueberries, raspberries, container nursery stock, woody nursery stock, shelterbelts and non-crop areas. **Sensitive Weeds:** Most weeds are susceptible to or suppressed by, dichlobenil including perennials, vetch and horsetail. **Uptake and Translocation:** Absorbed by the roots and rapidly translocated upward in the plant. **Basis of Selectivity:** Selectivity is based on physical separation between the dichlobenil vapour layer in the top 5 cm of soil and the established crop roots below this level. **Application Methods:** Applied preemergence to the weeds, preferably in either fall or early spring. **Residual Activity:** May persist and provide weed control for 2–6 months; higher rates and applications following use in previous year(s) may result in soil residues persisting for longer than 1 year. **Unique Characteristics:** Although applied as a granular herbicide it kills by means of a vapour phase in the top soil profile. Weed roots take up the herbicide as they enter this zone. Do not apply dichlobenil during periods of high soil temperature, since loss of control will result due to volatilization of the herbicide.

DICHLORPROP/2,4-D

Trade Names: DICHLORPROP D, DIPHENOPROP BK 700, ESTAPROP, TURBOPROP, WEEDONE CB. **Chemical Family:** Phenoxy/phenoxy. **Crop and/or Non-Crop Registrations:** Spring and fall wheat and barley; perennial weed and brush control on non-crop land. **Unique Characteristics:** Most properties of dichlorprop are very similar to those of 2,4-D. Chickweed, wild buckwheat, smartweed and some woody species are more sensitive to dichlorprop/2,4-D than to 2,4-D alone. Do not use on oats. See also 2,4-D.

DICLOFOP-METHYL

Trade Name: HOE-GRASS 284. **Chemical Family:** Aryloxyphenoxypropionate. **Crop and/or Non-Crop Registrations:** Potatoes, white beans, kidney beans, carrots, onions, snap beans, soybeans, rapeseed (canola), lima beans, wheat barley, mustard, alfalfa, clover, peas. **Sensitive Weeds:** Barnyard grass, foxtails, witch grass, fall panicum, wild oats, volunteer corn. **Uptake and Translocation:** Primarily through the leaves. Does not translocate significantly. **Basis of Selectivity:** Differential metabolism by tolerant vs. sensitive species. **Application Methods:** Postemergence when grass weeds are in the 1– to 4–leaf stage. **Residual Activity:** Essentially none. **Unique Characteristics:** Tank mixtures with broadleaf herbicides will result in reduced weed control. A time interval of 4 days before or after an application of diclofop-methyl is required.

DIFENZOQUAT

Trade Name: AVENGE 200C. **Chemical Family:** Quaternary ammonium. **Crop and/or Non-Crop Registrations:** Barley, spring wheat (Neepawa, Glenlea, Selkirk, Chester, Canuck, Benito, Columbus, Fielder, Leader, Katepwa, Conway, Kenyon, Lancer, Oslo, Genesis, Pasqua, Bluesky, Wildcat, Biggar and HY320 varieties only); triticale (Welsh and Carmen); winter wheat (Norstar and Sundance); fall rye (Cougar, Puma, Frontier, Rymin, Kodiak): canary seed; forages underseeded to barley or wheat. **Sensitive Weeds:**

Wild oats (tame oats also killed). **Uptake and Translocation:** Readily absorbed by foliage. Not translocated. **Basis of Selectivity:** Not established. **Application Methods:** Postemergence to actively growing wild oats at the 3– to 5–leaf stage. Do not apply to plants that are wet with dew or rain, or if rain is expected within 6 hr. **Residual Activity:** Essentially none. **Unique Characteristics:** The lower leaves of barley can be injured if cool weather conditions are present at the time of spraying or up to 2 days after. Frost or temperatures within 2 degrees of frost will accentuate this injury. This injury is usually temporary and does not reduce barley yield. See label for registered tank-mixes.

DIFLUFENZOPYR/DICAMBA

Trade Name: DISTINCT. **Chemical Family:** Semicarbazone/Benzoic acid. **Crop and/or Non-Crop Registrations:** Field Corn (silage and grain). **Sensitive Weeds:** Redroot pigweed, common ragweed, lamb's-quarters, wild buckwheat, lady's thumb, and velvetleaf. Control is best when weeds are actively growing. **Uptake and Translocation:** Readily absorbed by roots, stems or leaves and then translocated to other plant parts. **Basis of Selectivity:** Metabolism by tolerant species. **Application Methods:** Early postemergence to 6 leaf corn recommended. **Residual Activity:** Half-life in soil is approximately 30 days. Residue carryover into the next season is not a problem when applied at registered rates. **Unique Characteristics:** This product has a wider application window, a lower use rate and has better activity on perennial weeds than dicamba alone. Spray drift is toxic to sensitive plants in the same manner as 2,4-D, thus similar precautions should be followed. The auxin transport inhibitor, diflufenzopyr, will also be active with other growth hormone herbicides such as 2,4-D and clopyralid and may cause crop injury if tank-mixed. Do not use additives such as oils, ionic surfactants, wetting agents, sticking agents etc. Do not apply when there is a risk of severe drop in night temperature. Do not spray when temperatures are expected to exceed 27°C. Do not spray in high humidity or fog. Do not apply preemergence on sandy or sandy loam soils. Do not till or cultivate treated area for at least 7 days following application. The addition of a non-ionic surfactant at 0.25% v/v plus liquid nitrogen fertilizer 28-0-0 at 1.25% is recommended under postemergence applications.

DIMETHENAMID

Trade Name: FRONTIER. **Chemical Family:** Chloroacetamide. **Crop and/or Non-Crop Registrations:** Corn, dry beans and soybeans. **Sensitive Weeds:** Green and yellow foxtail, barnyard grass, fall panicum, witch grass, large and smooth crab grass, redroot pigweed and eastern black nightshade. **Uptake and Translocation:** Absorbed through shoots and roots of germinating grass and broadleaf weeds but primarily via plant coleoptile. **Basis of Selectivity:** Not established. **Application Method:** 1) preplant incorporated — incorporate with vibrating shank cultivator, harrow or other implement capable of giving uniform shallow incorporation into the top 5 cm of the soil within 7 days of planting; 2) Preemergence — rainfall is required within 10 days of appliation to achieve sufficient herbicide activation; 3) Early postemergence (corn only) — apply at the spike to 2–leaf stage of corn and up to the 2–leaf stage of annual grass weeds. **Residual Activity:** Provides season-long weed control. Length of residual activity depends upon soil and moisture factors, application rate and timing. Heavy rainfall following an incorporated treatment may reduce weed control. **Unique Characteristics:** No recropping restrictions in the fall or spring application in corn or soybeans. Application flexibility; there are many tank-mix and sequential treatment options for broad-spectrum weed control in corn and soybeans in all tillage systems (zero tillage to conventional tillage). Mixes well with bulk liquid and dry fertilizers.

DIQUAT

Trade Name: REGLONE DESICCANT. **Chemical Family:** Bipyridylium. **Crop and/or Non-Crop Registrations:** Desiccation of canola (rapeseed), flax, dry beans, dry peas, mustard, sunflowers, soybeans, adzuki beans, legume seed crops. Vine killing of potatoes. Control of corn spurry in oats. Stale seedbed and inter-row weeding. **Sensitive Weeds:** Any foliage contacted by diquat will be killed. **Uptake and Translocation:** Rapidly absorbed by foliage. Limited translocation. **Basis of Selectivity:** None. **Application Methods:** Postemergence. **Residual Activity:** Essentially none due to adsorption of chemical to soil particles. **Unique Characteristics:** Must be used with clean (non-turbid) water as the soil particles in muddy water drastically reduce the effectiveness of diquat. Apply in weather conditions that will not promote drift. For aerial application suggested conditions for good application are moderate temperatures (less than 25°C), humidity (greater than 40%) and wind (3.6–10 kph). Do not apply in dead calm conditions or when temperature inversion is likely (e.g., morning or evening when warm air is rising from crop). To avoid spray drift, use flat fan or hollow cone nozzles and a pressure of 140–210 kPa. For aerial application point the nozzles back 130°–180°. For further information on aerial application refer to the product label.

DIQUAT (AQUATIC)

Trade Name:, REWARD. **Chemical Family:** Bipyridylium. **Crop and/or Non-Crop Registrations:** Aquatic weed control in still or flowing water in ponds, ditches, lakes and canals. **Sensitive Weeds:** Coontail, Canada water weed, pondweeds, milfoil and duckweed. **Uptake and Translocation:** Contact desiccant with limited translocation. **Basis of Selectivity:** None. **Application Methods:** Postemergence. Apply when weeds are visible and are actively growing. It can be applied: with a boat bailer device that injects the chemical below the water surface; sprayed over the water surface; or poured directly from a container onto the surface. **Residual Activity:** Quickly inactivated by adsorption to soil particles. **Unique Characteristics:** Must be used with and applied on non-turbid water, as the soil particles in muddy water drastically reduce the effectiveness of the material.

Apply at dusk. Do not use treated water for swimming or consumption by humans or animals for at least 24 hr. Do not use water for irrigation for 5 days after treatment. To avoid fish kills caused by oxygen depletion, treat only 1/4–1/3 of the area at a time. Avoid application or drift onto crops, lawns, grazing areas, ornamental plants and other desirable plants.

DITHIOPYR

Trade Name: DIMENSION. **Chemical Family:** Pyridine. **Crop and/or Non-Crop Registrations:** Turf. **Sensitive Weeds:** Crab grass. **Uptake and Translocation:** Absorbed through the shoots and roots. Translocation is limited. **Basis of Selectivity:** Differential uptake, translocation and metabolism in sensitive seedling weeds vs. established plants. **Application Methods:** Preemergence or early postemergence up to the 3–leaf stage of crab grass. **Residual Activity:** Effective weed control may be maintained for 3 months. **Unique Characteristics:** Preemergence and early postemergence activity allows control of emerged plants and follow-up residual control of later germinating crab grass plants.

DIURON

Trade Name: KARMEX. **Chemical Family:** Substituted urea. **Crop and/or Non-Crop Registrations:** Grapes, asparagus, gladioli, industrial sites, right-of-ways. **Sensitive Weeds:** Annual and perennial grasses, pigweed, ragweed, wild carrot and dandelion. Perennial weed control at higher rates in non-crop areas. **Uptake and Translocation:** Most readily absorbed by roots, less so by foliage. Translocated upward in the xylem. **Basis of Selectivity:** Used only in deep-rooted crops that are well established. **Application Methods:** Applied to crops as a preemergence or directed early postemergence spray, preferably before weed growth becomes dense. Better control of emerged weeds is obtained by the addition of a suitable surfactant. In non-crop areas, diuron may be sprayed anytime except when ground is frozen. **Residual Activity:** At lower rates used in crops, residues last about a year and thus applications may be repeated annually. At higher non-crop rates, persistence may be more than 1 yr. **Unique Characteristics:** Should not be used where it is likely to leach or wash into contact with the roots of desirable trees or shrubs.

ENDOTHALL

Trade name: HERBICIDE 273. **Chemical Family:** dicarboxylic acid **Crop And/Or Non-Crop Registrations:** Sugar beets. **Sensitive Weeds:** Lady's-thumb, wild buckwheat, redroot pigweed, green foxtail and barnyard grass. **Uptake And Registration:** absorbed through the roots and shoots of actively growing weeds. **Basis Of Selectvity:** Not established. **Application Method:** 1) preemergence broadcast spray onto seedbed during or just after planting. May also mix with sand and apply as a banded treatment.
2) postemergence — apply as a broadcast or banded treatment only after the weeds have emerged. For best results, the sugar beets should be in the 4 to 6–leaf stage and the average temperature should be above 15°C. Do not apply later than 40 days after emergence. **Residual Activity:** Very short, up to 7 days. **Unique Characteristics:** High moisture after application is essential for the best weed control. Works very slowly. Only tankmix with betamix or betanex to expand weed control to include smartweed, knotweed, lamb's-quarters, ragweed, shepherd's-purse and nightshade.

EPTC

Trade Name: EPTAM. **Chemical Family:** Thiocarbamate. **Crop and/or Non-Crop Registrations:** Alfalfa, bird's-foot trefoil, snap or dry beans (including kidney), flax, potatoes, sunflowers and annual flowers. **Sensitive Weeds:** Annual grasses such as crab grass, barnyard grass, fall panicum, wild oats, green foxtail and yellow foxtail; yellow nut sedge; some annual broadleaf weeds such as corn spurry, lamb's-quarters, nightshade, pigweed and chickweed if conditions are favourable for germination and growth. **Uptake and Translocation:** Uptake by underground plant parts (roots, hypocotyl and seed). Upward translocation to the growing tip. **Basis of Selectivity:** Metabolized by tolerant species at the seed germination stage through enzymatic breakdown of the chemical. Seed food reserves also permit seedling to outgrow chemical effect. **Application Methods:** Preplant incorporated or postplant incorporated. May be applied using water or liquid fertilizers as the carrier. Dry fertilizers may also be used as a carrier when impregnated by licenced fertilizer dealers. To prevent chemical loss and reduced weed control, EPTC should be uniformly incorporated in the soil by setting the incorporation equipment (i.e., tandem disks, field cultivator with sweep teeth, or vibrating shank S-tine cultivator) to work the soil approximately 10 cm deep, followed by a levelling device. Irrigation (≈0.6 cm) can also be used to incorporate. When application and incorporation are done in separate operations, application should be a dry soil surface. **Residual Activity:** Applied in the spring preplant, EPTC provides season-long weed control with no soil residues the following year to prevent crop rotation. **Unique Characteristics:** EPTC does not need rainfall to activate and will not leach significantly under heavy rainfall. Under unfavourable germination conditions, leaf crinkling or leaf sealing may be observed on certain crops but usually without adverse effects on yield. May be tank-mixed with metribuzin for additional broadleaf weed control in potatoes. May be tank-mixed with ethalfluralin or trifluralin for additional broadleaf weed control in beans (white, snap and kidney). See label for other tank mix combinations and information on less conventional methods of application.

EPTC/R25788 (EPTC+)

Trade Name: ERADICANE. **Chemical Family:** Thiocarbamate. **Crop and/or Non-Crop Registrations:** Corn (ensilage, field and sweet). **Sensitive Weeds:** Annual grasses such as wild oats, crab grass, barnyard grass, foxtails, fall panicum; suppression of wild proso millet; yellow nut sedge, horsetail and some annual broadleaf weeds when conditions are favourable for germination and growth.

Uptake and Translocation: Uptake by underground plant parts (roots, hypocotyl and seed) then upward translocation to the growing tip. **Basis of Selectivity:** Metabolized by tolerant species at the seed germination stage through breakdown of the chemical. R25788 enhances the enzymatic breakdown of the chemical in tolerant species. Also, seed food reserves permit corn seedlings to outgrow chemical effect. **Application Methods:** EPTC/R25788 may be applied using water or liquid fertilizers as the carrier. Dry fertilizers may also be used as a carrier when impregnated by licenced fertilizer dealers. To prevent chemical loss and reduced weed control, EPTC/R25788 should be uniformly incorporated into the soil by setting the incorporation equipment (i.e., tandem disks, field cultivator with sweep teeth, or vibrating shank S-tine cultivator) to work the soil approximately 10 cm deep, followed by a levelling device. Irrigation (approximately 0.6 cm) can also be used to incorporate. When application and incorporation are done in separate operations, application should be to a dry soil surface and incorporation should be made within 4 hr. of application. Preplant incorporated EPTC+ may be used in tank-mix combination with 1) atrazine for additional broadleaf weed control or 2) metolachlor using reduced rates of both herbicides for more consistent control of many annual grasses. **Residual Activity:** Provides season-long weed control with no soil residues the following year to prevent crop rotation. In tank-mix combinations with atrazine, there may be atrazine residues when the highest atrazine rate is used. **Unique Characteristics:** EPTC/R25788 does not need rainfall to be activated and will not leach significantly under heavy rainfall.

ETHAMETSULFURON-METHYL

Trade Name: MUSTER. **Chemical Family:** Sulfonyl urea. **Crop and/or Non-Crop Registrations:** Spring Canola. **Sensitive Weeds:** Wild mustard. **Uptake and Translocation:** Following foliar application, is rapidly absorbed and translocated in both xylem and phloem. **Basis of Selectivity:** Inhibition of acetolactate synthase in susceptible plants leads to a rapid cessation of cell division and growth. Tolerant species rapidly convert ethametsulfuron-methyl to non-phytotoxic metabolites. **Application Methods:** Postemergence. **Residual Activity:** Rapid soil microbial degradation. **Unique Characteristics:** A non-ionic surfactant must be added. Typical symptoms of plant death (leaf crinkling, curling, chlorosis) occur 5–10 days after application depending on growing conditions.

ETHOFUMESATE

Trade Name: NORTRON. **Crop and/or Non-Crop Registrations:** Sugar beets. **Sensitive Weeds:** Chickweed, lamb's-quarters, kochia, redroot pigweed, Russian thistle, wild buckwheat, barnyard grass, large crab grass, foxtails and downy brome. **Uptake and Translocation:** Readily absorbed by emerging shoots (grass coleoptile and broadleaf hypocotyl) and roots, and translocated readily to the foliage. Postemergence applications of ethofumesate are poorly absorbed by maturing leaves with a well-developed cuticle. **Basis of Selectivity:** Tolerant species conjugate the herbicide, rendering it inactive. **Application Methods:** Preplant incorporated, preemergence. **Residual Activity:** Half-life of less than 5 to more than 14 weeks depending on soil temperature and moisture conditions. Half-life increases in cooler, drier soils.

FENOXAPROP-P-ETHYL

Trade Name: EXCEL SUPER, ACCLAIM SUPER. **Chemical Family:** Aryloxyphenoxypropionate. **Crop and/or Non-Crop Registrations:** EXCEL SUPER — Asparagus, broccoli, cabbage, cauliflower, carrots, dry common beans (kidney, pinto and white only), onions (dry bulb only), peas (field and processing), potatoes, canola (rapeseed), triazine-tolerant canola, soybeans, tomatoes. ACCLAIM SUPER — Lawns and Turf. **Sensitive Weeds:** Barnyard grass, green and yellow foxtail, crab grass, witch grass, wild proso millet, fall panicum, volunteer corn. **Uptake and Translocation:** Uptake primarily through the leaves. Does not translocate significantly. **Basis of Selectivity:** Differential metabolism by tolerant vs. sensitive species. **Application Methods:** Non-residual postemergence for the control of annual grasses (EXCEL SUPER: 1– to 6–leaf stage; ACCLAIM SUPER: 1– to 4–leaf stage plus 3 tillers). For best results, apply when weeds are young and actively growing. EXCEL SUPER — Do not apply if rainfall is expected within 1 hour of application. ACCLAIM SUPER — Do not apply if rainfall is expected within 3 hr. of application. **Residual Activity:** Essentially none. **Unique Characteristics:** EXCEL can be tank-mixed with BASAGRAN FORTE and/or PINACLE for broad-spectrum annual weed control in soybeans and dry beans only. If annual grasses are in the correct stage for application before broadleaf weeds have emerged, do not delay EXCEL SUPER application.

FLUAZIFOP-P-BUTYL

Trade Names: FUSILADE II, VENTURE. **Chemical Family:** Aryloxyphenoxypropionate. **Crop and/or Non-Crop Registrations:** Flax, canola, soybeans, sugar beets, sunflowers, tobacco, forage legumes (alfalfa, red clover and bird's-foot trefoil), cabbage, broccoli, brussel sprouts, califlower, cucumber, onions, potatoes, rutabagas, tomatoes, highbush blueberries, raspberries, strawberries, non-grassy ornamental plants, poplars, shrubs, trees, apples, apricots, cherries, cranberries, peaches, pears and plums, forest and ornamental nurseries. **Sensitive Weeds:** Annual grass species, volunteer corn, wheat, barley and quack grass. **Uptake and Translocation:** Absorbed primarily by leaves. Translocated to roots and rhizomes. **Basis of Selectivity:** Metabolism by tolerant species. **Application Methods:** Postemergence. Apply when grasses are actively growing, and annual grasses are in the 2– to 5–leaf stage and quack grass is in the 3– to 5–leaf stage. **Residual Activity:** Essentially none. **Unique Characteristics:** Preplant tillage to break up rhizomes will improve control of quack grass. Except as noted on the label, broadleaf herbicides should be

applied separately at least 3 days after fluazifop-p-butyl. Do not cultivate for 5 days after applying fluazifop-p-butyl. When plants are stressed (lack of moisture, excessive humidity, low temperature and/or very low relative humidity), fluazifop-p-butyl is less effective. Regrowth by tillering may occur if application is made under any of the above conditions. Since there is no residual activity, a new flush of weeds may emerge after the first flush has been controlled.

FLUFENACET/METRIBUZIN

Trade Name: AXIOM. **Chemical Family:** Oxyacetamide/triazine. **Crop and/or Non-Crop Registrations:** Corn and soybeans. **Sensitive Weeds:** Green, yellow, and giant foxtails, fall panicum, crab grass,barnyard grass, witch grass, redroot pigweed, lamb's-quarter, common ragweed, and wild mustard. **Uptake and Translocation:** Flufenacet is absorbed through shoots (primarily coleoptile) and roots of germinating grasses and broadleaf weeds. Metribuzin has some foliar uptake but the major route is via the roots. **Basis of Selectivity:** Metabolized by tolerant species. **Application Method:** Preemergence Residual Activity: Activity will normally be maintained for 10–14 weeks; late-germinating broadleaf weeds will not be controlled. **Unique Characteristics:** The rate depends on soil texture and weed abundance. Winter cereals may be planted 4 months after application. Many tank-mixes are registered for corn and soybeans. Do not use on muck soils or coarse textured soils with low organic matter.

FLUMETSULAM/CLOPYRALID

Trade Name: FIELDSTAR. **Chemical Family:** Triazolopyrimidine sulfonanilide/ pyridine. **Crop and/or Non-Crop Registrations:** Field corn. **Sensitive Weeds:** Common lamb's-quarters, redroot pigweed, Eastern black nightshade, common ragweed, velvetleaf, lady's-thumb. **Uptake and Translocation:** Flumetsulam and clopyralid are absorbed by both roots and shoots of germinating broadleaf weeds. **Basis of Selectivity:** Selectivity of flumetsulam in corn is based on metabolism. Basis of selectivity of clopyralid not established. **Application Methods:** Surface preplant, preplant incorporated, preemergence or early postemergence. **Residual Activity:** The most significant means of dissipation of both clopyralid and flumetsulam is microbial degradation. Provides season-long residual control of annual broadleaf weeds. Rotational crops are winter wheat, spring wheat, spring barley, oats, soybeans, field corn and seed corn. **Unique Characteristics:** Can be applied up to 15 days before planting. Recommended corn planting depth is at least 4 cm. Rainfall within 7–10 days is required for maximum activity of a surface preplant, preemergence or early postemergence application. Early postemergence applications can be made up to the 2–leaf stage of corn. Do not apply to areas where the soil pH is <5.9 or >7.8. Apply only to soils containing between 2%–5% organic matter. Do not apply to corn treated with a granular organophosphate insecticide as serious crop injury may occur. Do not apply when air temperature is near freezing or when freezing conditions are expected for several days following time of application. Extended cold, wet conditions (soil temperatures below 10°C for extended periods) or abnormally high soil moisture conditions during emergence and early crop development can cause injury symptoms on corn such as temporary yellowing of the leaves and/or crop stunting. Corn will quickly outgrow these symptoms once normal growing conditions resume. Do not apply to sweet corn, seed corn or popcorn.

FLUMETSULAM/CLOPYRALID/2,4-D

Trade Name: MAX (available only in ULTIMAX co-pack), STRIKER. **Chemical Family:** Triazolopyrimidine sulfonanilide/ Pyridine/ Phenoxy. **Crop and/or Non-Crop Registrations:** Field corn. **Sensitive Weeds:** Lamb's-quarters, redroot pigweed. Eastern black nightshade, common ragweed, velvetleaf, common chickweed, lady's-thumb. **Uptake and Translocation:** Flumetsulam, clopyralid and 2,4-D are absorbed by both roots and shoots of emerged and germinating broadleaf weeds. **Basis of Selectivity:** Selectivity of flumetsulam in corn is based on metabolism. Basis of selectivity of clopyralid and 2,4-D not established. **Application Methods:** Postemergence. **Residual Activity:** The most significant means of dissipation of flumetsulam, clopyralid and 2,4-D is microbial degradation. If adequate rainfall is received following application, STRIKER will provide residual control of late-germinating broadleaf weeds. Rotational crops are winter wheat, spring wheat, spring barley, oats, soybeans, common beans (dry, snap), lima beans, field corn and seed corn. **Unique Characteristics:** Do not apply beyond the 6–leaf stage of corn as serious crop injury may occur. Do not apply to corn treated with a granular organophosphate insecticide as serious crop injury may occur. Do not apply when air temperature is near freezing or when freezing conditions are expected within several days after time of application. Do not apply to sweet corn, seed corn or popcorn.

FLUMETSULAM/METOLACHLOR

Trade Name: BROADSTRIKE DUAL. **Chemical Family:** Triazolopyrimidine sulfonanilide/acetanilide. **Crop and/or Non-Crop Registrations:** Soybeans. **Sensitive Weeds:** Common lamb's-quarters, redroot pigweed, Eastern black nightshade, American nightshade, common ragweed, velvetleaf, cocklebur, barnyard grass, crab grass (smooth, hairy), foxtail (green, yellow, giant), fall panicum, old witch grass, yellow nut sedge. **Uptake and Translocation:** Flumetsulam and s-metolachlor are absorbed by both roots and shoots of germinating broadleaf weeds. S-metolachlor is absorbed by germinating grasses mainly through the shoot just above the seed. **Basis of Selectivity:** Selectivity of flumetsulam in soybeans is based on metabolism. Basis of selectivity of metolachlor not established. **Application Methods:** Surface preplant, preplant incorporated or preemergence. **Residual Activity:** The most significant means of dissipation of both s-metolachlor and flumetsulam is microbial degradation. Provides season-long residual control of annual broadleaf and

grass weeds. Rotational crops are winter wheat, spring wheat, spring barley, soybeans, common beans (dry, snap), lima beans, peas, field corn, seed corn. **Unique Characteristics:** Can be applied up to 21 days before planting. Rainfall within 7–10 days is required for maximum activity of a preemergence application. Do not apply to areas where the soil pH is more than 7.8 and organic matter is less than 2%. Do not apply to soils containing more than 5% organic matter. Suspension concentrate formulation separates into 2 phases over time. Shake container well before using.

FLUMETSULAM/S-METOLACHLOR

Trade Name: BROADSTRIKE DUAL MAGNUM. **Chemical Family:** Triazolopyrimidine sulfonanilide/acetanilide. **Crop and/or Non-Crop Registrations:** Soybeans. **Sensitive Weeds:** Common lamb's-quarters, redroot pigweed, Eastern black nightshade, American nightshade, common ragweed, velvetleaf, cocklebur, barnyard grass, crab grass (smooth, hairy), foxtail (green, yellow, giant), fall panicum, old witch grass, yellow nut sedge. **Uptake and Translocation:** Flumetsulam and s-metolachlor are absorbed by both roots and shoots of germinating broadleaf weeds. S-metolachlor is absorbed by germinating grasses mainly through the shoot just above the seed. **Basis of Selectivity:** Selectivity of flumetsulam in soybeans is based on metabolism. Basis of selectivity of metolachlor not established. **Application Methods:** Surface preplant, preplant incorporated or preemergence. **Residual Activity:** The most significant means of dissipation of both s-metolachlor and flumetsulam is microbial degradation. Provides season-long residual control of annual broadleaf and grass weeds. Rotational crops are winter wheat, spring wheat, spring barley, soybeans, common beans (dry, snap), lima beans, peas, field corn, seed corn. **Unique Characteristics:** Can be applied up to 21 days before planting. Rainfall within 7–10 days is required for maximum activity of a preemergence application. Do not apply to areas where the soil pH is more than 7.8 and organic matter is less than 2%. Do not apply to soils containing more than 5% organic matter. Suspension concentrate formulation separates into 2 phases over time. Shake container well before using.

FLUMETSULAM/TRIFLURALIN

Trade Name: BROADSTRIKE TREFLAN. **Chemical Family:** Triazolopyrimidine sulfonanilide/dinitroaniline. **Crop and/or Non-Crop Registrations:** Soybeans. **Sensitive Weeds:** Common lamb's-quarters, redroot pigweed, Eastern black nightshade, common ragweed, velvetleaf, cocklebur, barnyard grass, crab grass (smooth, hairy), foxtail (green, yellow), fall panicum, annual bluegrass, loose silky bentgrass, bromegrass. **Uptake and Translocation:** Flumetsulam is absorbed by both roots and shoots of germinating broadleaf weeds. No significant absorption or translocation of trifluralin. Susceptible weeds are controlled as they germinate. **Basis of Selectivity:** Selectivity to trifluralin is based on morphological characteristics of soybeans. Selectivity of flumetsulam in soybeans is based on metabolism. **Application Methods:** Preplant incorporated. Must be incorporated within 24 hr. after application. **Residual Activity:** The most significant means of dissipation of both trifluralin and flumetsulam is microbial degradation. Provides season-long residual control of annual broadleaf and grass weeds. Rotational crops, spring wheat, spring barley, soybeans, common beans (dry, snap), lima beans, peas, field corn, seed corn. **Unique Characteristics:** Can be applied up to 21 days before planting. Do not apply to natto soybean varieties as serious crop injury may occur. Do not apply to areas where (both apply) the soil pH is more than 7.8 and organic matter is less than 2%. Do not apply to soils containing more than 5% organic matter. Suspension concentrate formulation separates into 2 phases over time. Shake container well before using.

FOMESAFEN

Trade Name: REFLEX. **Chemical Family:** Diphenyl ether. **Crop Registrations:** Soybeans, beans (white, kidney and snap). **Sensitive Weeds:** Redroot pigweed, common ragweed, wild mustard, lady's-thumb, black nightshade, cocklebur; suppression of velvetleaf, lamb's-quarters. **Uptake and Translocation:** Taken up through foliage. Not readily translocated. **Mode of Action:** Cell-membrane disrupter. **Method of Selectivity:** Beans metabolize fomesafen. Some initial bronzing of crop leaves may occur, but plants normally outgrow this condition without any effect on maturity or yield. **Application Method:** Early postemergence to weeds and crop. Apply when beans are 1–2 trifoliate and weeds are at the 2– to 4–leaf stage. Good coverage is essential for optimum weed control. Apply in 200–350 L of water/ha at a pressure between 245–420 kPa. Always add an adjuvant such as AGRAL 90 (0.25% v/v) or TURBOCHARGE (0.5% v/v). PINNACLE or VENTURE may be tank-mixed for additional weed control. **Residual Activity:** Persistence depends on weather and soil conditions (more persistent under dry conditions). Rotation to field corn, dry beans or soybeans the following year. Winter wheat may be planted 90 days after treatment. All other crops require a field bioassay. **Unique Characteristics:** Do not apply REFLEX to any field more than once every 2 years.

FOSAMINE AMMONIUM

Trade Name: KRENITE. **Chemical Family:** Carbamoyl phosphonate. **Crop and/or Non-Crop Registrations:** Vine and brush control on non-crop land. **Sensitive Weeds:** Control and growth suppression of blackberry, oak, pine, sumac, maple, elder, elm, wild rose, hazel, aspen and beech. Cedar and spruce are quite tolerant. **Uptake and Translocation:** Absorption by young stems and foliage. Translocation has been observed from a treated mature leaf to all other parts of a plant but phloem transport with sugars is predominant. **Basis of Selectivity:** Not highly selective. **Application Methods:** Postemergence. Apply with high pressure ground equipment to ensure penetration of spray to thoroughly wet leaves, buds, stems and trunks of target brush. Surfactants are recommended to promote rapid leaf penetration. **Residual Activity:** Essentially none. **Unique Characteristics:** Woody plants treated with

fosamine ammonium die very slowly; the stems may not be completely killed 2 yr after treatment; the unsightly brown-out effect common to many other herbicides does not occur. Rainfall within 24 hr. of application may decrease effectiveness.

FUMIGANTS

(See metam sodium, methyl-bromide/chloropicrin)

GLUFOSINATE AMMONIUM

Trade Name: IGNITE, LIBERTY 200SN. **Chemical Family:** Unique. **Crop and/or Non-Crop Registrations:** IGNITE -Desiccation of dry beans and potatoes; directed applications in apples, grapes, peaches, pears and plums; stale seedbed techniques in asparagus, carrots, lettuce and onions; ground crack application in potatoes. LIBERTY 200SN — Corn hybrids and canola varieties specially developed to be tolerant to Liberty 200SN herbicide. Glufosinate-ammonium tolerant inbred lines grown for seed corn production. **Sensitive Weeds:** Non-selective — affects all actively growing green plants; regrowth of perennial species may occur. **Uptake and Translocation:** absorbed through foliage; minimal translocation — dependent on application rate and species treated. **Basis of Selectivity:** IGNITE — All green plant tissue is sensitive; safe on mature (non-green) bark of woody plants. LIBERTY 200SN — All green plant tissue is sensitive except for field corn, seed corn and canola plants that have been specially developed to be tolerant. **Application Methods:** IGNITE — Postemergence; broadcast or directed spray to avoid contact with leaves or green bark of desirable plants; thorough coverage of the plant tissue to be controlled is essential. LIBERTY 200SN — Postemergence. Can be broadcast in corn at the 1–8 leaf stage, apply with drop nozzles to later corn growth stages; cotyledon to early bolting stage in canola. **Residual Activity:** None; there are no cropping or rotational restrictions after application. **Unique Characteristics:** Speed of action is influenced by environmental factors; at cool temperatures, poor moisture and low humidity, speed of action may be reduced. Heavy dew at time of application may reduce control of certain weed species.

GLYPHOSATE TMS

Trade Name: TOUCHDOWN 480. See glyphosate.

GLYPHOSATE

Trade Names: CREDIT, CLEAR-IT 1, CLEAR-IT 2, CLEAR-IT 3, EXPEDITE GRASS & WEED, E-Z-JECT, GLYFOS, LAREDO, MAVERICK, RENEGADE, ROUNDUP, ROUNDUP DRY, ROUNDUP L & G, ROUNDUP TRANSORB, TOUCHDOWN 480, TOUCHDOWN 600, VANTAGE, VANTAGE PLUS, VISION, WRANGLER. **Chemical Family:** Amino acid. **Crop and/or Non-Crop Registrations:** CREDIT, GLYFOS, LAREDO, RENEGADE, ROUNDUP, ROUNDUP TRANSORB, VANTAGE, VANTAGE PLUS, WRANGLER — preplant or postharvest with no cropping restrictions. Preharvest in wheat, barley, soybeans, canola, flax, lentils, peas and forages. TOUCHDOWN 480 for preharvest use in canola, barley, field beans, field peas, soybeans and wheat. ROUNDUP, ROUNDUP TRANSORB, VANTAGE, AND VANTAGE PLUS for in-crop uses in Roundup Ready crops. Directed applications in ginseng, cherries, grapes, apples, pears, plums and peaches, strawberries as wiper or spot treatment. Non-crop registrations: EXPEDITE GRASS & WEED, ROUNDUP — brush control; turf renovation; chemical mowing; directed application in woody nursery stock, roadsides and shelterbelts. ROUNDUP - asparagus. E-Z-JECT — selective woody brush and tree control. VISION — silvicultural site preparation, conifer release, forest tree plantings, forest tree nurseries. **Sensitive Weeds:** Annual grasses; perennial weeds (quack grass, Canada thistle, sow-thistle, field bindweed, milkweed, cattails, nut sedge, poison-ivy etc.); brush (birch, alder, poplar, raspberry, willow and maple. **Uptake and Translocation:** Absorbed through foliage and translocated throughout the plant. **Basis of Selectivity:** Non-selective for agricultural crops. Conifers are tolerant at some stages but the basis has not been established. **Application Methods:** Postemergence, usually at the bud to bloom stage of growth for most perennial weeds. Canada thistle should be at least in early flower bud, milkweed at flower bud, and bindweed at full flower. Quack grass can be treated in the spring or fall when it is actively growing with at least 3–4 new leaves on each emerged shoot; in the fall, remove crop refuse but do not till prior to application; fall or spring tillage prior to spring application may reduce control; wait at least 3–5 days after application before working the area; for maximum control it is advisable to till before the quack grass turns completely brown. Glyphosate can be applied with boom equipment, knapsack sprayers and high-volume equipment for agricultural and non-crop uses. Backpack mist blowers may be used for silvicultural site preparation and roadside brush control only. Aerial applications may be used for silvicultural site preparation and conifer release only. Can also be applied with selective equipment for non-crop areas, tree plantings, grapes and orchards (See sections entitled "Special Methods of Weed Control" and "Selective Weed Control with Wiper Applicators"). Regardless of method of application, do not allow herbicide solution to contact green foliage or green bark of crop or other desirable plants; remove all suckers from the trunks of desirable trees before spraying. **Residual Activity:** None: crops can be planted or seeded directly into treated areas following application. Other herbicides are required to control weeds emerging after the application. **Unique Characteristics:** Rainfall within 6 hr. after application or heavy frost within 24 hr. may reduce control. ROUNDUP TRANSORB is rainfast as soon as 4 hr. after application.

GLYPHOSATE/GLUFOSINATE AMMONIUM

Trade Name: ROUNDUP FASTFORWARD PRESEED, ROUNDUP FASTFORWARD PREHARVEST. **Chemical Family**: Amino acid/Unique. **Crop and/or Non-Crop**

Registrations: ROUNDUP FASTFORWARD PRESEED — Preplant treatments with no cropping restrictions. ROUNDUP FASTFORWARD PREHARVEST — Preharvest treatments in wheat, drybeans, canola, flax, peas, and lentils. **Sensitive Weeds**: Annual grass and broadleaf weeds and many perennials such as quack grass and Canada thistle. **Translocation:** Absorbed through foliage and translocated throughout the plant. **Basis of Selectivity:** Non-selective for agricultural crops. **Application Methods**: Postemergence to actively growing weeds using boom equipment (see glyphosate note for more information). **Residual Activity:** None: Crops can be planted directly into the treated areas following application. **Unique Characteristics**: Glyphosate/glufosinate ammonium provides quicker burndown of green vegetation than glyphosate alone. Rainfall within 2 hr. after application or a heavy frost within 24 hr. may reduce control.

HERBICIDAL OIL

(See MINERAL OIL [HERBICIDAL].)

HEXAZINONE

Trade Names: PRONONE, VELPAR. **Chemical Family:** Triazine. **Crop and/or Non-Crop Registrations:** Christmas trees, coniferous reforestation, non-crop land. **Sensitive Weeds:** Most herbaceous broadleaf weeds and grasses including raspberry, bluejoint grass, goldenrod and brome grass; spot applications control aspen, ash, maple, cherry and birch. **Uptake and Translocation:** Absorbed through roots and foliage; translocation is primarily upwards through xylem. **Basis of Selectivity:** Tolerant species metabolize hexazinone faster than sensitive species. For conifers, at least part of the selectivity is due to the tree roots being deeper than hexazinone leaches into the soil. **Application Methods:** For broadcast applications, apply preemergence or as a postemergence foliar spray during active plant growth. For spot applications, use an exact- delivery hand gun applicator to apply undiluted VELPAR-L as close as possible to the root collar of plants to be controlled; keep spots at least 1 m away from desirable conifers. Apply PRONONE with an approved granular applicator. **Residual Activity:** Half-life of 2 months on a Flanagan silt loam in Illinois. Half-life of 2½ months on a silty clay in northern Ontario. **Unique Characteristics:** Rainfall is needed to activate hexazinone in the soil. Do not use on sandy, gravelly or rocky soils, or on frozen ground. Do not apply on steep slopes. Do not apply to areas where the roots of desirable trees may extend. Liquid formulation is flammable. A bioassay may be used to determine soil residue levels when sensitive crops are to be planted in soil treated with hexazinone.

IMAZAMOX

Trade Name: VIPER (Available only in VIPER co-pack), MERIDIAN (Available only in MERIDIAN PLUS co-pack.

IMAZAMOX+BENTAZON

Trade Name: MERIDIAN PLUS (co-pack of MERIDIAN+BASAGRAN FORTE). **Chemical Family**: Imidazolinone+ Benzothiadiazine. **Crop Registrations**: Soybeans. **Sensitive Weeds**: Annual grass (barnyard grass, green and yellow foxtail, fall panicum) and broadleaf (cocklebur, lamb's-quarters, pigweed, ragweed, velvetleaf, lady's-thumb, wild mustard, eastern black nightshade) species including triazine resistant biotypes **Uptake and Translocation:** Contact and systemic. Absorption occurs through foliage and roots. **Basis of Selectivity:** Metabolism by soybeans. **Application Methods**: Postemergence, weeds should be actively growing and be between the second and sixth leaf stage. A liquid ammonium fertilizer solution (such as UAN) must be added at 2 L/ha. **Unique Characteristics**: Some rotational restrictions apply (See label for details).

IMAZAMOX+FOMESAFEN

Trade Name: VIPER (co-pack of VIPER+REFLEX). **Chemical Family**: Imidazolinone+diphenyl ether. **Crop Registrations**: Soybeans. **Sensitive Weeds**: Annual grass (barnyard grass, green and yellow foxtail, witch grass) and broadleaf (cocklebur, lamb's-quarters, pigweed, ragweed, velvetleaf, lady's-thumb, mustards, nightshades) species including triazine resistant biotypes **Uptake and Translocation:** Contact and systemic. Absorption occurs through foliage and roots. **Basis of Selectivity:** Metabolism by soybeans. **Application Methods**: VIPER is a postemergent program and should be applied to actively growing weeds in the cotyledon to 6 true-leaf stage once soybeans have reached the first trifoliate stage. Addition of a non-ionic surfactant and liquid fertilizer solution are required. VIPER also provides control of some late-emerging weeds. **Residual Activity:** Rotational crops include field corn, soybeans, winter wheat. **Unique Characteristics**: Some rotational restrictions apply (See label for details).

IMAZAPYR

Trade Name: ARSENAL. **Chemical Family:** Imidazolinone. **Crop and/or Non-Crop Registrations:** Non-crop/non-graze areas such as industrial sites, railroad ballast, spot treatments for rail and highway rights-of-way and pipeline rights-of-way stations including well sites, battery stations and compressor or valve stations. **Sensitive Weeds:** Annual and perennial grass and broadleaf weeds such as: annual — black medick, rough cinquefoil, common groundsel, hemp-nettle, kochia, lamb's-quarters, mustard spp., pigweed spp., pineappleweed, ragweed spp., Russian thistle, stinkweed, annual sow-thistle, wild buckwheat, annual bluegrass, foxtail spp., witch grass; biennial/perennial — bladder campion, bull thistle, burdock, Canada thistle, sulfur cinquefoil, clover spp., dandelion, dog-strangling vine, field bindweed, goat's beard, goldenrod, leafy spurge, milkweed, mouse-eared chickweed, mullein spp., ox-eye daisy, plantain spp., poison-ivy, sheep sorrel, toadflax, tufted vetch, wild carrot, wild grape, wild strawberry, brome grass, Canada bluegrass, fescue spp., quack grass, yellow nut sedge; Seedling woody species — maple, poplar, raspberry and wild rose. **Uptake**

and Translocation: Absorbed by both roots and foliage of sensitive vegetation. Translocated in both the xylem and phloem. **Basis of Selectivity:** None. **Application Methods:** Postemergence on actively growing weeds. Control of non-emerged sensitive species will also be provided in the year of application. Apply in 100–550 L of water/ha with high-volume, high-pressure handguns and vehicle-mounted directed-spray equipment or conventional boom-mounted, manifold-mounted or off-centred nozzles. Low-volume, hand-held backpacks, knapsacks or other pump-up-type sprayers may also be used for direct applications to foliage. Addition of non-ionic surfactant at 1 L/400 L of spray solution is recommended for spray volumes greater than 550 L/ha. A foam-reducing agent may be added at the recommended rate, if required. **Residual Activity:** Season-long control of sensitive species. **Unique Characteristics:** Do not contaminate ponds, lakes, streams, wetlands or sloughs and do not apply within 15 m of a wetland area or body of water. Do not mix or store in unlined steel (except stainless steel) containers or spray tanks. For ground application only. Do not use where roots from desirable vegetation may extend into the treated area (maintain a distance from desirable trees equal to at least twice the distance from the trunk to the dripline). To be used by licensed applicators only.

IMAZETHAPYR

Trade Name: CONQUEST B (Available only in CONQUEST co-pack), PURSUIT. **Chemical Family:** Imidazolinone. **Crop and/or Non-Crop Registrations:** Soybeans, white beans, kidney beans, snapbeans, imidazolinone-tolerant corn (IR), processing peas and alfalfa for seed production. **Sensitive Weeds:** Soil applications — green foxtail, yellow foxtail, old witch grass, barnyard grass, lamb's-quarters, redroot pigweed, smartweed, lady's-thumb, wild mustard, velvetleaf, common ragweed and reduced competition from eastern black nightshade and proso millet. Postemergence application — green foxtail, yellow foxtail, witch grass, barnyard grass, redroot pigweed, velvetleaf, wild mustard, cocklebur, eastern black nightshade, ragweed and reduced competition from proso millet, large crab grass, lamb's-quarter's, wild buckwheat and yellow nut sedge. Late postemergence application — green and yellow foxtail (up to 4–leaf stage), barnyard grass (up to 6–leaf stage), redroot pigweed (up to 12–leaf stage) and velvetleaf (up to 8–leaf stage). **Uptake and Translocation:** Absorbed by both roots and foliage. Translocation in both xylem and phloem. **Basis of Selectivity:** Metabolism by tolerant species. **Application Methods:** Early preplant (up to 30 days before planting), preplant incorporated, preemergence and postemergence up to the 2–leaf stage of weeds, and late postemergence on specific weeds (see Sensitive Weeds). **Residual Activity:** Persistence depends on weather and soil conditions (more persistent under dry conditions). Rotational cropping restricted to soybeans, white beans, kidney beans, processing peas, corn, spring barley, spring wheat and winter wheat. Do not plant other crops the year following application as injury may result. **Unique Characteristics:** Can be applied up to 30 days prior to planting. Registered for use in reduced and no-till situations. Tank mixing is recommended for heavy infestations of ragweed or barnyard grass. Postemergence application requires the addition of AGRAL 90, AGSURF or ENHANCE surfactant and liquid fertilizer solution. Temporary soybean discoloration and/or shortening may occur with postemergence applications. A period of 100 days is required between application and planting winter wheat.

IMAZETHAPYR/ATRAZINE

Trade Name: PATRIOT. **Chemical Family:** Imidazolinone/s-triazine **Crop and/or Non-Crop Registrations:** Imazethapyr tolerant corn. **Sensitive Weeds** Annual grass and broadleaf species inlcuding triazine resistant biotypes. See label for specific species controlled. **Application Methods:** Postemergence. **Unique Characteristics:** Some rotational restrictions apply. See label for details. Refer to notes on imazethapyr and atrazine for additional information on each component.

IMAZETHAPYR+BENTAZON

Trade Name: CLEANSWEEP (co-pack of PURSUIT + BASAGRAN FORTE). **Chemical Family:** Imidazolinone+ Benzothiadiazine. **Crop and/or Non-Crop Registrations:** Soybeans. **Sensitive Weeds:** Annual grass (barnyard grass, green and yellow foxtail) and broadleaf (cocklebur, flower-of-an-hour, lady's-thumb, lamb's-quarters, pigweed, ragweed, shepherd's-purse, stinkweed, velvetleaf, wild mustard, eastern black nightshade) species including triazine resistant biotypes and reduced competition from yellow nut sedge, Canada thistle and field bindweed. **Uptake and Translocation:** Contact and systemic. Absorption occurs through foliage and roots. **Basis of Selectivity:** Metabolism by soybeans. **Application Methods:** Post emergence. **Unique Characteristics:** A liquid ammonium fertilizer solution (such as UAN) must be added at 2L/ha. Some rotational restrictions apply. See label for details. Refer to notes on imazethapyr and bentazon for additional information on each component.

IMAZETHAPYR+METRIBUZIN

Trade Name: CONQUEST (co-pack of CONQUEST A + CONQUEST B). **Chemical Family:** Imidazolinone+s-triazine. **Crop and/or Non-Crop Registrations:** Soybeans. **Sensitive Weeds:** Annual grass and broadleaf species. See label for specific species controlled. **Application Methods:** Preplant incorporated and preemergence. **Unique Characteristics:** Some rotational restrictions apply. See label for details. Refer to notes on imazethapyr and metribuzin for additional information on each component.

IMAZETHAPYR/PENDIMETHALIN

Trade Name: VALOR. **Chemical Family:** Imidazolinone/dinitroaniline. **Crop and/or Non-Crop Registrations:** Soybeans. **Sensitive Weeds:** Annual grass and broadleaf species including triazine-resistant biotypes. See label for specific species controlled. **Application Methods:** Preplant

incorporated. **Unique Characteristics:** Some rotational restrictions apply. See label for details. Refer to notes on imazethapyr and pendimethalin for additional information on each component.

ISOXAFLUTOLE+ATRAZINE

Trade Name: CONVERGE (co-pack of CONVERGE 75DF + CONVERGE 480). **Chemical Family:** Isoxazole+s-triazine. **Crop and/or Non-Crop Registrations:** Corn, field. **Sensitive Weeds:** Annual grasses and broadleaf weeds including triazine and ALS inhibitor tolerant biotypes: green, yellow and giant foxtail, barnyard grass, witch grass, large and smooth crabgrass, lamb's-quarters, pigweed, common ragweed, eastern black nightshade, velvetleaf, wild mustard, wormseed mustard, wild buckwheat, lady's-thumb, seedling dandelion and seedling plantain. **Uptake and Translocation:** Absorbed by roots and shoots of germinating weeds. **Basis of Selectivity:** Metabolized by tolerant species. Preemergence. Provides season long weed control. Winter wheat can be grown 4 months after application, corn, soybeans, spring cereals, alfalfa, and potato can be grown the following year. Weed seedlings that emerge prior to activation of herbicide by rainfall can be controlled if less than 5 cm in height. For use on sandy loam or finer textured soils with a minimum of 2% organic matter.

ISOXABEN

Trade Name: GALLERY. **Chemical Family:** Benzamide. **Crop and/or Non-Crop Registrations:** Bareroot and container conifer seedlings. **Sensitive Weeds:** St. John's-wort, pineappleweed, lamb's-quarters, purslane, shepherd's-purse, low cudweed and purslane speedwell. **Uptake and Translocation:** Absorbed by roots and translocated to the shoots of germinating weeds. **Basis of Selectivity:** Root selectivity. **Application Methods:** Applied prior to weed emergence in conifers, 4 or more weeks after crop germination and emergence. Rainfall or irrigation is needed to activate the herbicide. **Residual Activity:** Provides season-long control. Germination of some sensitive crop species may be reduced in the year following treatment. **Unique Characteristics:** Gallery is registered for use only by members of the Canadian Forest Nursery Weed Management Association.

LINURON

Trade Name: AFOLAN F, LINURON 480, LOROX DF, LOROX L. **Chemical Family:** Substituted urea. **Crop and/or Non-Crop Registrations:** Corn, soybeans, carrots, celery, dill, parsnips, potatoes, asparagus, wheat, oats, barley, gladioli, fruit trees. **Sensitive Weeds:** Annual weeds such as barnyard grass, common chickweed, corn spurry, crab grass, velvetleaf, fall panicum, foxtail, goosefoot, goose grass, groundsel, knotweed, lamb's-quarters, redroot pigweed, purslane, common ragweed, shepherd's-purse, smartweed, stinkweed, wild buckwheat, witch grass, wormseed mustard, triazine-resistant weeds; seedlings only of dandelion, plantain and sow-thistle. **Uptake and Translocation:** Readily absorbed through roots, less so through foliage; translocation primarily upwards in xylem. **Basis of Selectivity:** Differencial metabolism often coupled with differential uptake and translocation. **Application Methods:** Preemergence, postemergence, directed postemergence, pre plus postemergence. **Residual Activity:** Does not pose a problem for subsequent crops since phytotoxic residues from applications at agricultural rates disappear within 4 months. **Unique Characteristics:** Do not use on sandy or coarse-textured soils having less than 2% organic matter. If unusually heavy rains follow application, severe injury may occur to corn, soybeans, carrots and potatoes.

MALEIC HYDRAZIDE

Trade Name: ROYAL MH 60 SG. **Chemical Family:** Unique. **Crop and/or Non-Crop Registrations:** Growth control in lawns, turf, trees and shrubs. Sprout control in stored onions and potatoes. **Sensitive Weeds:** Controls the growth of wild onion, garlic and biennial-type weeds such as dandelion and plantain when applied in the fall. **Uptake and Translocation:** Absorbed through foliage. Translocated to active growing points in plant. Translocated more effectively downwards. **Basis of Selectivity:** Not established. **Application Methods:** Postemergence. Use as a foliar spray. Dosage and stage of plant development are critical factors. To reduce or eliminate mowing, apply in the spring or fall to green non-dormant grass; can be mixed with 2,4-D for spring applications. For tree and shrub growth control, apply to the portion of the plant on which growth is to be inhibited; growth control is best when applied to vigourous new growth; spray leaves and bark to point of run-off. **Residual Activity:** None. **Unique Characteristics:** Do not apply on or near crops being grown for seed. Rain within 24 hr. after application will reduce effectiveness. Since temporary discoloration of grass may result, this chemical is recommended for use in areas where mowing grass is difficult and where lawn-like appearance is not necessary.

MCPA

Trade Names: ESTEMINE, MCPA, MCPA-SODIUM SALT, MCPA AMINE. **Chemical Family:** Phenoxy. **Crop and/or Non-Crop Registrations:** Cereal crops, turf, non-crop sites. **Sensitive Weeds:** Many broadleaf weeds, especially buttercup, hemp-nettle, field horsetail (top growth only), seedling dock. **Uptake and Translocation:** Absorbed through leaves or roots. Translocates to, and accumulates at, growing points of shoots and roots. **Basis of Selectivity:** Differences in interception, penetration, translocation, metabolism and sensitivity of active sites leads to greater activity in broadleaf weeds than grasses. **Application Methods:** Post-emergence. **Residual Activity:** Some soil residues can be detected for up to 1 month under moist conditions and 2 months under drier conditions. **Unique Characteristics:** MCPA is available in amine ester or sodium salt formulations. It is safer than 2,4-D for use on oats, flax and peas. As with 2,4-D, there is a potential drift hazard to nearby

susceptible crops such as grapes, turnips, tobacco and cabbage.

MCPB/MCPA

Trade Name: CLOVITOX PLUS, TROPOTOX PLUS. **Chemical Family:** Phenoxy/phenoxy. **Crop and/or Non-Crop Registrations:** Seedling white, ladino, alsike or red clovers direct seeded or underseeded in wheat, oats, barley, rye, pastures, field corn, peas, grapes. **Sensitive Weeds:** Small emerged mustards, stinkweed, ragweed, lamb's-quarters, redroot pigweed, shepherd's-purse, volunteer rapeseed, wild radish, hemp-nettle, annual sow-thistle; top-growth control of bull thistle, Canada thistle, curled dock, plantain, perennial sow-thistle, field bindweed, horsetail, buttercup. **Uptake and Translocation:** Absorbed through the foliage and readily translocated, especially to the growing points. **Basis of Selectivity:** MCPB is not directly toxic to plants. Susceptible weeds convert MCPB to MCPA. **Application Methods:** Postemergence. In cereals, clovers and peas, apply as an overall spray. In corn, apply with drop pipes after the corn reaches 45 cm before the beginning of tasselling. Apply to pastures after grazing or cutting.

MECOPROP

Trade Names: COMPITOX, MCPP, MECO-D, MECOPROP. **Chemical Family:** Phenoxy. **Crop and/or Non-Crop Registrations:** Cereals, turf. **Sensitive Weeds:** Many broadleaf weeds such as chickweed, cleavers, plantain, clover, corn spurry, stitchwort, black medick, knotweed, shepherd's-purse, buttercup, Canada thistle (top-growth control) and dandelion. For complete control of Canada thistle, dandelion and black medick, a repeat application will likely be required. **Uptake and Translocation:** Absorbed readily by foliage and translocated to roots and throughout shoots, especially to growing points. **Basis of Selectivity:** Differences in interception, penetration, translocation, metabolism and sensitivity of active sites result in broadleaf species being more sensitive than grasses. **Application Methods:** Postemergence. Apply to cereals between the 3–leaf and early flag-leaf stage. In lawns and turf, apply when weeds are actively growing (May, June and September). **Residual Activity:** Can persist in soil up to 4 weeks, however, grass can normally be seeded within 1–2 weeks after treatment. **Unique Characteristics:** Controls 2,4-D-resistant weeds such as chickweed, clovers, black medick and young knotweed. Do not spray on grain underseeded to legumes. If cereals are stressed at the time of application, deformed heads and missing florets may result. Can be safely used on bentgrass, however, injury may occur if temperature is above 27°C. Effectiveness will be reduced if rain occurs within 4–6 hr. after treatment.

MECOPROP/2,4-D

Trade Names: EXPEDITE BROADLEAF, MECO-D, MECOPROP PLUS 2,4-D, MECOTURF PLUS 2,4-D, PREMIUM 2–WAY TURF HERBICIDE, TURF-RITE 2+2. **Chemical Family:** Phenoxy/phenoxy. **Uptake and Translocation:** Absorbed through leaves and roots, translocates to growing points. **Basis of Selectivity:** Differences in interception, penetration, translocation, metabolism and sensitivity of active sites result in broadleaf species being more sensitive than grasses. **Application Methods:** Postemergence. Apply when weeds are actively growing. EXPEDITE BROADLEAF is a ready-to-use formulation that must be applied with Expedite application equipment.

METAM SODIUM

Trade Name: VAPAM **Chemical Family:** Thiocarbamate. **Crop and/or Non-Crop Registrations:** Field and greenhouse seedbeds. Field-replant sites of fruits, vegetables, tobacco, ornamentals and forest-tree stock. **Sensitive Weeds:** Most scarified weed seeds and freshly vegetative parts including rhizomes and germinating seedlings. **Basis of Selectivity:** Most plant parts are sensitive. Crops are not planted until all fumigant has dissipated from the soil. With moisture, methyl isothiocyanate gas is released, which kills most scarified seeds and fleshy vegetative parts including rhizomes and germinating seedlings. **Application Methods:** Apply uniformly using injectors, water or other incorporation tools to carry the product to the desired soil depth. May be applied via the irrigation system. No gas-proof cover is required unless the soil is very porous, however, a sprinkler application of water should be used to provide a surface "water seal". **Residual Activity:** 10–40 days depending on soil temperature and the amount of organic matter present in the soil. Persistence is greatest at low temperatures and high levels of organic matter. Planting may take place 12–16 days after the treatment and following a lettuce-seedling bioassay that indicates no injury. **Unique Characteristics:** Also controls nematodes, soil fungi and soil insects. All traces of toxic gases must be dissipated from the treated soil before planting or plant injury may occur.

METHYL BROMIDE/CHLOROPICRIN

Trade Name: TERR-O-GAS 67. **Chemical Family:** Organohalogen. **Crop and/or Non-Crop Registrations:** Greenhouse and tobacco seedbeds. Methyl bromide is very poisonous to humans and livestock; only an experienced operator should attempt its use. **Sensitive Weeds:** Gas is toxic to germinating seedlings. **Application Methods:** Formulated as a liquid under pressure, that, when released from the container, forms a gas. Soil must be sealed with a plastic sheet since the gas is highly volatile. Refer to label for detailed directions. **Unique Characteristics:** Methyl bromide gas is highly volatile and highly poisonous to humans and livestock. It may be absorbed by inhalation, ingestion and skin contact. A permit must be obtained from the Ontario Ministry of the Environment each time it is used. Also controls soil insects, nematodes and fungal diseases.

METOBROMURON

Trade Name: PATORAN FL. **Chemical Family:** Substituted urea. **Crop and/or Non-Crop**

Registrations: Soybeans, dry common beans (kidney, white, yellow-eye), lima beans, snap common beans, adzuki beans, potatoes. **Sensitive Weeds:** Annual broadleaf weeds (including triazine-tolerant biotypes) such as pigweed, lamb's-quarters, green smartweed, ragweed, lady's-thumb, shepherd's-purse, annual nightshades, cudweed, corn spurry, groundsel, purslane, chickweed, mustards and stinkweed. Some activity on annual grasses such as barnyard grass, crab grass, green foxtail, witch grass, annual bluegrass and stink grass. The annual grasses are the first to escape treatment. **Uptake and Translocation:** Absorbed through the roots. Translocated in the transpiration stream to the leaves where it accumulates at the margins. **Basis of Selectivity:** Achieved through differential interception of the herbicide. Metobromuron must be placed on the soil surface and move into the zone of germinating weed seeds but not come in contact with the roots of the germinating crop plants. **Application Methods:** Preemergence. For beans, apply before the beans and weeds emerge; beans should be planted 4–5 cm deep; shallow-planted crops may be injured; do not use on soils with less than 2% organic matter; optimum organic levels are 2%–5%. For potatoes, metobromuron should be applied at ground crack after the first hilling, provided the soil completely covers the emerged potato tips. **Residual Activity:** Relatively short (6–8 weeks). **Unique Characteristics:** Moisture is required for distribution into the top layer of soil where weed seeds are germinating. Soil residues do not carry-over to affect subsequent crop rotations.

METOLACHLOR

See S-METOLACHLOR

METOLACHLOR/ATRAZINE

SEE S-METOLACHLOR/ATRAZINE

METRIBUZIN

Trade Names: CONQUEST A (Available only in CONQUEST co-pack), EVICT SOLUPAK, LEXONE DF, SENCOR 500 F, SENCOR 75 DF, SENCOR SOLUPAK. **Chemical Family:** S-triazine. **Crop and/or Non-Crop Registrations:** Established asparagus, faba beans, potatoes, soybeans, transplant tomatoes, apples, apricots, peaches, cherries, corn and triazine-tolerant canola with trifluralin or with terbacil or with metolachlor on apples, apricots, cherries, plums, peaches and pears. **Sensitive Weeds:** Lamb's-quarters, wild mustard, redroot pigweed, common ragweed, shepherd's-purse, lady's-thumb, velvetleaf, jimsonweed, prostrate pigweed, Russian thistle, yellow wood-sorrel, prickly mallow, chickweed, cocklebur, carpetweed, dandelion seedlings, barnyard grass, crab grass, foxtail, fall panicum, witch grass, Johnson grass seedlings and cheat grass. **Uptake and Translocation:** Some uptake through the foliage but the major route is via the roots. Translocation upwards in the xylem. **Basis of Selectivity:** Degradation by tolerant species. **Application Methods:** Preplant incorporated (potatoes, soybeans, apples, apricots, peaches, cherries, corn, tomatoes and triazine-tolerant canola); preemergence (asparagus, potatoes, soybeans and triazine-tolerant canola); postemergence (potatoes, tomatoes, corn and triazine-tolerant canola). **Residual Activity:** Varies with the climate. At normal-use rates the half-life is 1–2 months. **Unique Characteristics:** Heavy rainfall following application may cause crop damage. Some varieties of potato, soybean and tomato are less tolerant than others. Triazine-resistant weeds are not controlled. Do not use on muck soils.

METRIBUZIN+S-METOLACHLOR

Trade Name: BOUNDARY (co-pack of SENCOR 500F + DUAL MAGNUM). **Chemical Family:** S-triazine+Acetanilide. **Crop and/or Non-Crop Registrations:** Soybeans. **Sensitive Weeds:** Annual grass and broadleaf species. See label for specific species controlled. **Application Methods:** Preplant incorporated and preemergence. **Unique Characteristics:** Refer to notes on s-metolachlor and metribuzin for additional information on each component.

MINERAL OIL (HERBICIDAL)

Trade Name: AGRICULTURAL WEED KILLER NO. 1. **Chemical Family:** Aliphatic and aromatic hydrocarbons. **Crop and/or Non-Crop Registrations:** Carrot, celery, dill, parsley, parsnips. **Sensitive Weeds:** Annual weeds with the exception of ragweed, wormweed and wild carrot. **Uptake and Translocation:** Absorbed by foliage. Little or no translocation. **Basis of Selectivity:** Low-interception species such as the Umbelliferae family are tolerant. **Application Methods:** Postemergence; broadcast or banded. For carrots, dill, parsley and parsnips, apply as soon as true leaves develop and before roots are thicker than a pencil. For celery, apply as soon as true leaves develop. Weeds should be less than 10 cm tall. Best results will be obtained if spray is applied on cool sunny mornings; do not apply when excessively hot. **Residual Activity:** None. **Unique Characteristics:** Do not apply within 30 days of harvest as late application may flavour the harvested crop.

MONOLINURON

Trade Name: AFESIN. **Chemical Family:** Substituted urea. **Crop and/or Non-Crop Registrations:** Soybeans, white beans, yellow eye beans, kidney beans, lima beans, snapbeans, potatoes. **Sensitive Weeds:** Particularly effective on most annual broadleaf weeds including triazine-resistant biotypes. Some activity on annual grasses but these will be the first to escape. Cultivation may be required. **Uptake and Translocation:** Uptake is primarily through the roots of germinating weed seedlings, although leaf uptake is possible. Translocated upwards in the xylem to the shoots. **Basis of Selectivity:** Monolinuron is placed on the soil surface and moves down into the zone of germinating weed seeds but not deep enough to come in contact with the roots of germinating crop plants. **Application Methods:** Preemergence. For beans, apply before the beans and weeds emerge; beans should be planted 4–5 cm deep; shallow-planted crops may be injured; do not use on soils with less than 3% organic matter. On potatoes, apply preemergence or when plants are covered by

hilling. **Residual Activity:** Relatively short, 4–6 weeks. **Unique Characteristics:** Moisture is required for distribution into the top layer of soil where weed seeds are germinating.

NAPROPAMIDE

Trade Names: DEVRINOL 50 DF, DEVRINOL 50W, DEVRINOL 10G. **Chemical Family:** Amide. **Crop and/or Non-Crop Registrations:** Asparagus, cole crops (cabbage, broccoli, cauliflower, Chinese broccoli, Chinese mustard greens, Chinese Nappa cabbage, Chinese radish), garlic, kohlrabi, peppers, pumpkin, squash, fuzzy squash, rutabagas, tomatoes, tobacco, raspberries, blackberries, cultivated lowbush blueberries, established highbush blueberries, boysenberries, cranberries, loganberries, newly planted or established strawberries, apples, grapes, peaches and pears, newly transplanted or established ornamentals, woody nursery stock, forest tree stock and container-grown ornamentals (see label for species). With simazine or with terbacil on new plantings of apples, apricots, cherries, plums, peaches and pears. **Sensitive Weeds:** Many annual weeds including crab grass, barnyard grass, annual bluegrass, foxtails, sandbur, wild oats, goose grass, chickweed, groundsel, redroot pigweed, lamb's-quarters, purslane, prostrate knotweed, pineappleweed and prickly lettuce. **Uptake and Translocation:** Absorbed through the roots of germinating weeds. Translocated upward through seedling. **Basis of Selectivity:** Metabolized by tolerant species. Root growth of germinating seedlings is inhibited. Established plants are not affected due to placement selectivity. **Application Methods:** May be applied preplant incorporated using water as the carrier. Incorporation should be uniform, and to a chemical depth of 2.5–5 cm, using irrigation or proper incorporation equipment (e.g., tandem discs or field cultivator with sweep teeth) followed by a levelling device. On established crops, apply to a weed-free soil surface and irrigate in if no rainfall occurs within 7 days after application in spring or fall, or within 2 days after application in summer; irrigate with sufficient water to wet the soil to a depth of 5–10 cm (approximately 7 mm of rain). For post-plant application in tobacco, apply in 25 cm band over the row. Cross-disc or cross-plough after harvest to dilute soil residue before planting cover crop. **Residual Activity:** Provides season-long weed control if properly incorporated. Deep ploughing will minimize any carryover effect. **Unique Characteristics:** Will not control germinated weeds. Resists leaching. To avoid injury to crops not registered for use with napropamide, do not plant until 12 months after the last napropamide application.

NAPTALAM

Trade Name: ALANAP. **Chemical Family:** Amide. **Crop and/or Non-Crop Registrations:** Cucumbers, melons, squash and pumpkins. **Sensitive Weeds:** Seedlings of bindweed, chickweed, cocklebur, lamb's-quarters, pigweed, purslane, ragweed, velvetleaf, crab grass and foxtail. **Uptake and Translocation:** Inhibits seed germination and may be absorbed through the root system after germination. **Application Methods:** Preemergence. Soil clods should be thoroughly broken up and pulverized to give a smooth surface before spray applicaton. Apply up to 48 hr. after planting. Following applications, the soil should not be disturbed unless later weed growth makes cultivation necessary. A second application may be applied to cucumbers and melons about 1 month after the first spray, when the crop has emerged but before the weeds are up. Use lower rates on light soil, higher rates on heavy soil. **Residual Activity:** Completely decomposes in 6–8 weeks. **Unique Characteristics:** Do not apply during very wet, cold weather as stunting of the crop may result. Avoid spray drift to areas planted to sensitive crops such as beets, tomatoes and spinach.

NICOSULFURON

Trade Name: ACCENT. **Chemical Family:** Sulfonylurea. **Crop and/or Non-Crop Registrations:** Field corn, certain varieties only of sweet corn, and seed corn (contact seed source for details on specific inbreds). **Sensitive Weeds:** Quack grass, proso millet, green and yellow foxtail, fall panicum, barnyard grass, old witch grass. **Uptake and Translocation:** Following foliar absorption, nicosulfuron is rapidly absorbed through the leaves and translocated in both xylem and phloem. **Basis of Selectivity:** Inhibition of acetolactate synthase (ALS) enzyme in susceptible plants leads to a rapid cessation of cell division and regrowth. Tolerant species rapidly convert nicosulfuron to non-phytotoxic metabolites. **Application Method:** Postemergent within the 1 to 8–leaf stage of corn. **Residual Activity:** No soil residual activity. **Unique Characteristics:** Emerged grasses will be controlled by nicosulfuron but subsequent germinating grasses will not be controlled. A non-ionic surfactant must be added at 0.2% v/v. Typical symptoms of plant death (chlorosis, necrosis) occur 5–10 days after application, depending on growing conditions. Do not apply to corn that has been treated with an organophosphorus soil insecticide (i.e., COUNTER, LORSBAN, THIMET, CYGARD or DI-SYSTON).

NICOSULFURON/RIMSULFURON

Trade Name: ULTIM. **Chemical Family:** Sulfonylurea/Sulfonylurea. **Crop and/or Non-Crop Registrations:** Field corn. Not for use on sweet or seed corn. **Sensitive Weeds:** Quack grass, proso millet, green and yellow foxtail, fall panicum, barnyard grass, witch grass, redroot pigweed (incl. triazine-resistant). **Uptake and Translocation:** Following foliar application, nicosulfuron/rimsulfuron rapidly absorbed through the leaves and translocated in both xylem and phloem. **Basis of Selectivity:** Inhibition of acetolactate synthase (ALS) enzyme in susceptible plants leads to a rapid cessation of cell division and growth. Tolerant species rapidly convert nicosulfuron/rimsulfuron to non-phytotoxic metabolites. **Application Method:** Postemergent, within the 1– to 6–leaf stage of corn. **Residual Activity:** Rapid soil microbial degradation. **Unique Characteristics:** Emerged grasses will be controlled by nicosulfuron/rimsulfuron, but subsequent germinating grass weeds will not be controlled. A non-ionic surfactant must be added at 0.2% v/v. Typical

symptoms of plant death (chlorosis, necrosis) occur 5–10 days after application, depending on growing conditions. Tank mix with cyanazine, bromoxynil or dicamba for control of broadleaf weeds. Do not apply to corn that has been treated with an organophosphorous soil insecticide (i.e., COUNTER, LORSBAN, THIMET, CYGARD or DI-SYSTON). Do not use on corn hybrids with a crop heat unit (CHU) rating of 2500 or less, or in geographic regions with 2500 or less average seasonal CHU. Nicosulfuron/rimsulfuron should not be sprayed for weed control in fields planted with some hybrids. SEE THE LABEL FOR LIST.

NICOSULFURON/RIMSULFURON+ FLUMETSULAM/CLOPYRALID/2,4-D

Trade Name: ULTIMAX (co-pack of ULTIM+MAX). **Chemical Family:** Sulfonylurea + Sulfonylurea/Pyridine/Phenoxy. **Crop and/or Non-Crop Registrations:** Field corn. **Sensitive Weeds:** Quack grass, proso millet, green and yellow foxtail, fall panicum, barnyard grass, witch grass, redroot pigweed, common ragweed, velvetleaf, common chickweed, lady's thumb. **Uptake and Translocation:** Rapidly absorbed through the leaves and translocated in both xylem and phloem. **Basis of Selectivity:** Selectivity of nicosulfuron, rimsulfuron, and flumetsulam is based on metabolism. Basis of selectivity of clopyralid and 2,4-D is not known. **Application Method:** Postemergent, up to the 6–leaf stage of corn. **Residual Activity:** If adequate rainfall is received following application, ULTIMAX will provide some residual control of late germinating annual broadleaf and grass weeds. **Unique Characteristics:** Typical symptoms of plant death (chlorosis, necrosis) occur 5–10 days after application, depending on growing conditions. Favourable growing conditions will speed the activity while cool or dry conditions will delay activity. Do not apply to corn that has been treated with an organophosphorous soil insecticide (i.e., COUNTER, LORSBAN, THIMET, CYGARD or DI-SYSTON). Do not apply beyond the 6–leaf stage of corn as serious crop injury may result. Do not use on corn hybrids with a crop heat unit (CHU) rating of 2500 or less, or in geographic regions with 2500 or less average seasonal CHU. ULTIMAX should not be sprayed on certain sensitive hybrids. READ THE LABEL FOR COMPLETE LIST.

OXADIAZON

Trade Name: RONSTAR 2G. **Chemical Family:** Oxadiazole. **Crop and/or Non-Crop Registrations:** Woody ornamental shrubs, vines and trees grown in containers. **Sensitive Weeds:** Annual weeds including stinkweed, bittercress, common groundsel, lamb's-quarters, purslane, black nightshade, pigweeds, redroot, tumble, shepherd's-purse, annual bluegrass, barnyard grass, green and yellow foxtails and crab grass. **Uptake and Translocation:** Primarily taken up through emerging shoots when they penetrate through the treated soil layer. **Basis of Selectivity:** Greater physiological tolerance relative to susceptible species and lack of contact with sensitive crop tissue. **Application Method:** Applications may be made to both newly transplanted and established ornamentals preemergent to weed germination. Existing weed growth must be removed for satisfactory weed control. **Residual Activity:** 60–120 days **Unique Characteristics:** When applied to soil, the material is rapidly and strongly fixed by soil colloids. Due to its low water solubility and to this adsorption, the downward and lateral movement is limited under the influence of rain or irrigation. Therefore, the chemical must be applied uniformly for satisfactory weed control. Moisture is required to activate the chemical. Rainfall or overhead irrigation after application will improve weed control.

OXYFLUORFEN

Trade Name: GOAL. **Chemical Family:** Diphenyl ether. **Crop and/or Non-Crop Registrations:** Onions. **Sensitive Weeds:** Purslane, pigweed, annual nightshades, wild buckwheat, lamb's-quarters. **Uptake and Translocation:** Primarily foliar absorption but some root absorption. Very little movement within the plant following foliar or root absorption. **Application Methods:** Postemergence. Best control is obtained when weeds are in the 2– to 4–leaf stage and actively growing. The first application can be made when onions have 2 fully developed true leaves. Repeat applications may be necessary to control late-germinating weeds. Use at least 500 L of water/ha. **Residual Activity:** Limited preemergence activity. **Unique Char acteristics:** Use on dry bulb onions. Do not use when crop or weeds are under stress. Do not apply within 56 days prior to harvest.

PARAQUAT

Trade Name: GRAMOXONE. **Chemical Family:** Bipyridylium. **Crop and/or Non-Crop Registrations:** Apples, apricots, cherries, currants, gooseberries, grapes, highbush blueberries, peaches, pears and plums established more than 1 yr; blackberries, loganberries and red raspberries; inter-row spraying in strawberries; stale seedbed technique for vegetables and field crops; inter-row directed chemical weeding for vegetable fields and established nursery crops; asparagus; potatoes; established alfalfa and bird's-foot trefoil; pasture renovation; zero tillage corn; conifer control; turf renovation; chemical mowing weed control in non-crop land; aquatic weed control. **Sensitive Weeds:** Non-selective — affects all green plants. **Uptake and Translocation:** Absorbed by foliage and green bark; little or no translocation. **Basis of Selectivity:** All green plant tissue is sensitive. Less effective on plants with a very waxy cuticle and linear leaf shape such as nut sedge. Safe on mature (non-green) bark of woody plants. **Application Methods:** Postemergence. Broadcast, or directed spray to avoid contacting leaves or bark of desirable plants. Apply when weeds are less than 15 cm high. Better results are usually obtained if application is made on a dull or cloudy day, or in the evening. **Residual Activity:** Essentially no residual activity in soil. Will persist in organic material such as mulches or turf thatch; therefore, do not reseed these areas for 5 days. More than one application per season may be necessary, especially for perennial weeds. **Unique**

Characteristics: Inactivated by adsorption to soil particles. Not available to homowners. For a domestic registration, see paraquat/diquat.

PARAQUAT/DIQUAT

Trade Names: WEED AND GRASS KILLER, WEED-BAN. **Chemical Family:** Bipyridylium/bipyridylium. **Crop and/or Non-Crop Registrations:** "Chemical mower" to control weeds on driveways, pathways and other non-cultivated areas. **Sensitive Weeds:** All green plant tissue. Less effective on plants with a thick, waxy cuticle such as nut sedge. **Uptake and Translocation:** Foliar contact activity. Little or no translocation. **Basis of Selectivity:** No selectivity for green plants. Will not penetrate the mature (non-green) bark of woody plants. **Application Method:** Postemergence. **Residual Activity:** Essentially none; inactivated by adsorption to soil particles. May remain active in turf thatch after application, therefore, thorough cultivation of a turf area is required before seeding. **Unique Characteristics:** Best results follow application on dull or cloudy days, or in the evening.

PEBULATE

Trade Name: TILLAM. **Chemical Family:** Thiocarbamate. **Crop and/or Non-Crop Registrations:** Tobacco, tomatoes, red beets, and sugar beets. **Sensitive Weeds**: Barnyard grass, crab grass, green foxtail, yellow foxtail, wild oats, yellow nut sedge, horsetail, lamb's-quarters, prostrate pigweed, purslane, redroot pigweed. **Uptake and Translocation:** Absorbed by roots, hypocotyl and seed. Translocated upward to growing point. **Basis of Selectivity:** Tolerant species degrade herbicide. Also food reserves in seed allow seedling to outgrow chemical effect. **Application Method:** Preplant incorporated. May be applied using water or liquid fertilizer as the carrier. Dry fertilizers may also be used as the carrier when impregnated by a licenced fertilizer dealer. Incorporate uniformly into the soil by setting the incorporation equipment (ie. tandem disks, field cultivator, with sweep teeth or vibrating shank s-tine cultivator) to work soil approximately 10 cm deep followed by a levelling device. Irrigation (approximatley 0.6 cm) can also be used to incorporate. When application and incorporation are separate operations, application should be to a dry soil surface. **Residual Activity:** Provides season long weed control without soil residues the following season. **Unique Characteristics:** Rainfall is not required for activation. Leaching is not significant, even with a heavy rainfall.

PENDIMETHALIN

Trade Name: PROWL. **Chemical Family:** Dinitroaniline. **Crop and/or Non-crop Registrations:** Onions and field corn. **Sensitive Weeds:** Green foxtail, yellow foxtail, crab grass, barnyard grass, fall panicum, common chickweed, lamb's-quarters and pigweed. **Uptake and Translocation:** Weeds are controlled as they germinate. Translocation is not significant and emerged weeds are not controlled. **Basis of Selectivity:** No significant uptake or translocation by the crop. **Application Methods:** Onions: postemergence to the crop at loop and 2–leaf stage. Field corn: preemergence and early postemergence. For preemergence application, pendimethalin may be applied in water or liquid fertilizer. A fertilizer compatibility test should be carried out using pendimethalin and any of its registered tank-mix partners. Early postemergence application may only use water as a carrier. **Residual Activity:** Persistence depends on weather conditions (more persistent under dry conditions). Only registered crops may be planted in the year of application. Soybeans and corn may be planted the year following application in corn. Days to harvest restriction: 100 days. **Unique Characteristics:** Strongly adsorbed to soil particles. Most effective when rain is received within 7 days of application. For onions, application at both growth stages is required for season-long control. Tank mixes in corn or sequential application of other herbicides in onions and corn are required for broad-spectrum weed control. Registered for dry bulb onions grown on muck soil only. DO NOT graze treated fields or feed treated foliage to livestock prior to 100 days after PROWL application.

PHENMEDIPHAM

Trade Name: SPIN-AID. **Chemical Family:** Phenylcarbamate. **Crop and/or Non-Crop Registrations:** Red (table) beets. **Sensitive Weeds:** Lamb's-quarters, wild buckwheat, green foxtail, yellow foxtail, mustard. **Uptake and Translocation:** Phenmedipham is absorbed by the leaves where it acts by inhibiting the Hill reaction in the chloroplasts of leaf cells. **Application Method:** Postemergence. **Residual Activity:** Half-life of phenmedipham is approximately 25 days. **Unique Characteristics:** Phenmedipham may injure beets that are under stress. It may cause temporary growth retardation and/or chlorosis or tip-burn on red beets. Beets usually resume normal growth within 10 days.

PICLORAM/2,4-D

Trade Name: TORDON 101 MIXTURE. **Chemical Family:** Pyridine/phenoxy. **Crop and/or Non-Crop Registrations:** Weed and brush (including conifer) control in non-crop locations, industrial sites and rights-of-way. **Sensitive Weeds:** Most broadleaf herbaceous weeds including Canada thistle, sweet and red clover, wild carrot, common ragweed, dandelion, goldenrod, dock, plantain, prickly lettuce, burdock, fleabane and vetch; deciduous and coniferous woody plants except white ash. **Uptake and Translocation:** Rapidly absorbed by the roots, stems and foliage. Translocation can be up or down but, like 2,4-D, accumulation is in young, rapidly growing meristematic tissue. **Basis of Selectivity:** Effects on nucleic acid metabolism and growth are not observed in grasses and other tolerant species. **Application Methods:** For deciduous and coniferous brush, apply either broadcast using a fixed nozzle (constant volume per hectare) or selectively using a spray gun (variable volume per hectare). As spray gun applications use a more dilute spray mix, this type of application must thoroughly wet the foliage, stem and root collar. Brush should be

treated after foliage is well developed in spring or early summer. To ensure thorough coverage and minimize drift, brush to be treated should be less than 2.5 m tall. For cut-surface treatment, mix with water or ethylene glycol (to reduce the freezing point, if necessary) and apply to cover the cambium layer of freshly cut stumps. For broadleaf herbaceous weeds, apply broadcast in spring or early summer after growth begins. **Residual Activity:** Soil residue carryover into the year following application is minimal when applied at recommended rates. Degradation is most rapid under warm, humid conditions. Because small residues of picloram in soil can be phytotoxic to crops such as soybeans, tobacco, tomatoes, potatoes, grapes and many desirable ornamental plants, picloram may not be applied to land used, or land that may be used, for the production of agricultural and horticultural crops. **Unique Characteristics:** A permit from the Ministry of the Environment is required for the purchase and use of picloram/2,4-D in Ontario. Picloram/2,4-D must not be applied over, or near, areas where roots of desirable trees or other plants may extend. Because spray drift is phytotoxic to sensitive plants, an approved drift-control system or additive is recommended when making low-volume applications adjacent to desirable trees or crops.

PRIMISULFURON/DICAMBA

Trade Name: SUMMIT. **Chemical Family:** Sulfonyl urea/benzoic acid. **Crop and/or Non-Crop Registrations:** Field corn. **Sensitive Weeds:** Quack grass, lamb's-quarters(including triazine tolerant), redroot pigweed, mustards, common ragweed, velvetleaf. **Uptake and Translocation:** Following foliar application and uptake,translocation through the phloem to meristematic tissues. **Basis of Selectivity:** Metabolism by tolerant species. **Application Methods:** Postemergence, within the 2– to 7–leaf stages of corn. **Residual Activity:** Degradation primarily by soil microbial activity. Will provide some control of later germinating broadleaf weeds. See the label and *Table 2* for rotational restrictions. **Unique Characteristics:** Will control quack grass and broadleaf weeds. An adjuvant must be added at 0.2% v/v. Apply when temperature, during the 24 hr. before and after the application, ranges between 5°C and 28°C. Do not use on seed or sweet corn. Do not apply to corn treated with an organophosphate insecticide.

PROMETRYNE

Trade Name: GESAGARD **Chemical Family:** S-triazine. **Crop and/or Non-Crop Registrations:** Carrots, peas, leeks, and transplanted celery. **Sensitive Weeds:** Lamb's-quarters, lady's-thumb, corn spurry, pigweed, wild mustard, purslane, eastern black nightshade, chickweed, hemp-nettle and green foxtail. **Uptake and Translocation:** Absorbed through foliage and roots. Translocated upwards through xylem, accumulating in the apical meristems. **Basis of Selectivity:** Metabolized by tolerant plants and to a lesser extent by sensitive plants, although this is not thought to be the major selective mechanism. **Application Methods:** Preemergence or early postemergence (before weeds are 5 cm high). Apply before carrots or peas emerge. Apply 7–14 days after celery is transplanted. **Residual Activity:** About 6–8 weeks. A fall cover crop of rye or oats may be sown on the treated land in the same season.

PROPANIL/MCPA

Trade Name: STAMPEDE CM. **Chemical Family:** Acetanilide/phenoxy. **Crop and/or Non-Crop Registrations:** Spring wheat, barley and oats. **Sensitive Weeds:** Green and yellow foxtail; certain broadleaf weeds such as wild buckwheat, lady's-thumb and pale smartweed. **Uptake and Translocation:** Propanil is absorbed by leaves; translocated to growing point of shoot and then back to other leaves. MCPA is absorbed by leaves; translocated to growing points of shoot and root. **Basis of Selectivity:** Faster metabolism of herbicide by tolerant species. **Application Methods:** Postemergence. Best control is obtained when weeds are small and actively growing, relative humidity is high and daily maximum temperature exceeds 21°C. Apply when cereals are in the 2– to 5–leaf stage and weeds are in the 1– to 4-leaf stage. Do not apply if daily maximum temperature is not expected to exceed 10°C or if frost is expected within 24 hr. Thorough spray coverage is necessary. **Residual Activity:** None. **Unique Characteristics:** May cause crop yellowing or tip burn but these effects are temporary and normally disappear in 10–14 days.

PROPYZAMIDE

Trade Name: KERB. **Chemical Family:** Amide. **Crop and/or Non-Crop Registrations:** Alfalfa, bird's-foot trefoil, woody nursery stock, lettuce, apples, pears, lowbush blueberries. **Sensitive Weeds:** Perennial grasses including quack grass, annual grasses, volunteer cereals and common chickweed. **Uptake and Translocation:** Taken up by plant roots and translocated to the foliage. Little foliar absorption. **Basis of Selectivity:** Faster degradation in tolerant species. **Application Methods:** Preemergence to annual weeds. Postemergence control of perennial grasses when applied in the fall. Apply in the fall from late September to early November when the soil temperature is low but above freezing, and soil moisture is high. **Residual Activity:** Persistence is variable (2–9 months), depending on soil type and climatic conditions. Decomposition of the herbicide is slow at temperatures below 15°C but accelerates at temperatures above this level. Persistence is greatest in sandy soils with low organic matter. **Unique Characteristics:** Rainfall or irrigation is required after application to move the herbicide into the root zone for uptake by perennial grasses and germinating annual grasses.

PROSULFURON

Trade Name: PEAK. (Available only in PEAKPLUS co-pack)

PROSULFURON/DICAMBA

Trade Name: PEAKPLUS (co-pack of PEAK+BANVEL II). **Chemical Family:** Sulfonyl urea+benzoic acid.. **Crop and/or Non-Crop**

Registrations: Field corn. **Sensitive Weeds:** Lamb's-quarters (including triazine tolerant), redroot pigweed, cocklebur, lady's thumb, wild mustard, velvetleaf, common ragweed. **Uptake and Translocation:** Following foliar application and uptake, prosulfuron is translocated through phloem to meristematic tissues. Growth of susceptible species ceases rapidly, followed by discolouration of leaves; death takes one to three weeks to occur. **Basis of Selectivity:** Inhibition of the enzyme acetolactate synthase. Tolerant species rapidly metabolize prosulfuron. **Application Methods:** Postemergent, within the 2 to 7–leaf stages of corn. **Residual Activity:** Degradation primarily by soil microbial action. Prosulfuron will provide a sufficient degree of control of later germinating broadleaf weeds. Approved rotational crops are soybeans, dry beans, peas, cereals, and corn. See the label and *Table 5* for rotational restrictions **Unique Characteristics:** Prosulfuron must be applied in a tank-mix combination with a reduced rate of dicamba. Refer to the corn recommendation section for products and rates. An adjuvant must be added at 0.2% v/v. Do not apply to corn treated with a granular organophosphate insecticide.

PYRAZON

Trade Name: PYRAMIN FL. **Chemical Family:** Pyridazinone. **Crop and/or Non-Crop Registrations:** Sugar beets and table beets. With NORTRON on sugar beets. **Sensitive Weeds:** Annual nightshades, chickweed, knotweed, lady's-thumb, lamb's-quarters, oak-leaved goosefoot, prostrate pigweed, purslane, ragweed, redroot pigweed, shepherd's-purse, smartweed, stinkweed, wild buckwheat, wild carrot (seedling), wild mustard, wormseed mustard and yellow rocket (seedling). **Uptake and Translocation:** Can be taken up by both roots and leaves, but translocation is upward to leaves where it inhibits photosynthesis. **Basis of Selectivity:** Metabolism by tolerant species. **Application Methods:** Preplant incorporated, preemergence, or postemergence after the second true-leaf stage of the beets. **Residual Activity:** Average persistence is about 4–8 weeks in soil, depending on soil moisture and temperature. Residue carryover problems are unlikely. **Unique Characteristics:** With preemergence applications, at least 1.25 cm of rainfall is required for good weed control. Combinations of pyrazon and TCA are most useful where both annual broadleaf weeds and grasses are a problem. These treatments may not be effective on high organic soils or dry soils (i.e., muck soils or with late planted beets when soils are drier). Under these circumstances, postemergence applications of pyrazon plus TCA as a band over the row may be most effective. However, to be selective and effective the chemicals must be applied after the cotyledons of the beets are 2.5 cm long and before the weeds have reached the 4 true-leaf stage (10 cm). Where TCA has been used, beet tops should not be fed to livestock. TCA residues in the soil can be a problem for some crops such as corn.

PYRIDATE

Trade Name: LENTAGRAN. **Chemical Family:** Phenyl pyridazine. **Crop and/or Non-Crop Registrations:** Cabbage, corn (field, sweet, seed), tomato. **Sensitive Weeds:** Annual broadleaf weeds (1– to 4–leaf stage) including triazine-resistant species, certain annual grasses (1– to 3–leaf stage) when the weeds are actively growing. Pyridate alone: lamb's-quarters and redroot pigweed. For Pyridate plus atrazine on corn and for pyridate plus metribuzin on tomatoes: lamb's-quarters, redroot pigweed, nightshade, purslane, ragweed (common), wild mustard, velvetleaf and suppression of buckwheat (wild), lady's-thumb (smartweed), barnyard grass, crab grass (hairy), foxtail (green and yellow). Where heavy annual grass pressure is a problem, use a specific preemergence grass herbicide. **Uptake and Translocation:** Rapidly absorbed by leaves and acts as a contact only. **Basis of Selectivity:** It penetrates into both sensitive and tolerant plants but is quickly metabolized and inactivated in tolerant crops such as corn,. In sensitive weeds, activity is evident by marginal yellowing, followed by yellowing and browning of the entire leaf. This visible evidence generally occurs within 4–7 days after application. Activity is more rapid at higher temperatures and under good growing conditions. Weed control under drought conditions may be decreased. **Application Method:** Postemergence. Sprays can be applied overall on corn and directed on transplanted tomatoes. **Residual Activity:** None. **Unique Characteristics:** Combination with triazine herbicides improves total weed control. The stage of the weed, not the stage of the corn, determines application date. Tomatoes will show temporary yellowing, which is reduced by directing the spray to the bottom one-third of well-established tomato plants. Uptake by leaves is very rapid and rainfall shortly after application (1–2 hr.) has little effect on the degree of control.

QUIZALOFOP-P-ETHYL

Trade Name: ASSURE II. **Chemical Family:** Aryloxyphenoxypropionate. **Crop and/or Non-Crop Registrations:** Canola, flax, snap beans, seed alfalfa, soybeans and sugar beets. **Sensitive Weeds:** Green foxtail, barnyard grass, fall panicum, old witch grass, proso millet, wild oats, volunteer cereals and volunteer corn. **Uptake And Translocation:** Rapidly absorbed and readily translocated in both the xylem and phloem from the treated foliage to the root system and growing points of the plant. **Basis Of Selectivity:** Disruption of fatty acid biosynthesis leading to increased permeability and cellular disruption in sensitive plants. Rapid metabolism of the active herbicide in tolerant species. **Application Methods:** Postemergence. **Residual Activity:** Rapid microbial degradation and essentially no soil activity. **Unique Characteristics:** Apply with CANPLUS-411 at 5–10 L/1000 L of spray solution or SURE-MIX at 5 L/1000 L of spray solution. Tank-mix with PINNACLE or PINNACLE + BASAGRAN FORTE for control of broadleaf weeds.

RIMSULFURON

Trade Name: ELIM EP, PRISM. **Chemical Family:** Sulfonylurea. **Crop and/or Non-Crop Registrations:** ELIM EP - Field corn. Not for use on sweet or seed corn. PRISM - Potatoes, transplanted processing tomatoes. Not for use on potatoes grown for

seed. **Sensitive Weeds:** Green foxtail, fall panicum, barnyard grass, redroot pigweed (incl. triazine-resistant), hairy nightshade, Suppression of yellow foxtail, witch grass, lamb's-quarters. **Uptake and Translocation:** Following foliar application, rimsulfuron is rapidly absorbed through the leaves and translocated in both xylem and phloem. **Basis of Selectivity:** Inhibition of acetolactate synthase (ALS) enzyme in susceptible plants leads to a rapid cessation of cell division and growth. Tolerant species rapidly convert rimsulfuron to non-phytotoxic metobolites. **Application Method:** Postemergent, within the spike-3–leaf stage of corn. Prior to initiation of flowering in potatoes. **Residual Activity:** Rapid soil microbial degradation. **Unique Characteristics:** Emerged grasses will be controlled by rimsulfuron, but subsequent germinating grass weeds will not be controlled. A non-ionic surfactant must be added at 0.2%v/v. Typical symptoms of plant death (chlorosis, necrosis) occur 5–10 days after application, depending on growing conditions. Tank-mix with dicamba for control of broadleaf weeds in corn. Do not apply rimsulfuron to corn that has been treated with an organophosphorous soil insecticide (i.e., COUNTER, LORSBAN, THIMET, CYGARD or DI-SYSTON). Do not use rimsulfuron on corn hybrids with a Crop Heat Unit (CHU) rating of 2500 or less, or in geographic regions with 2500 or less average seasonal CHU. Rimsulfuron should not be sprayed for weed control in fields planted with some hybrids. SEE THE LABEL FOR LIST.

S-METOLACHLOR

Trade Names: DUAL MAGNUM, DUAL II MAGNUM. **Chemical Family:** Acetanilide. **Crop and/or Non-Crop Registrations:** Corn, soybeans, snap beans (yellow and green only), dry beans (white, kidney and pinto only), lima beans, transplanted cole crops (cabbage, cauliflower, broccoli), transplanted tomatoes, potatoes, sugar beets, processing peas, rutabagas and sweet white lupins, apples, apricots, cherries, peaches, pears and plums. **Sensitive Weeds:** Large and smooth crab grass; witch grass; barnyard grass; fall panicum; giant, green and yellow foxtail; yellow nut sedge; American nightshade, eastern black nightshade. **Uptake and Translocation:** Absorbed by germinating grasses mainly through shoot just above seed. Absorbed by germinating broadleaf weeds through roots and shoots. **Basis of Selectivity:** Metabolized by tolerant species. **Application Methods:** Early preplant, preplant incorporated and preemergence. Early postemergence on corn (spike to 2–leaf stage of corn). Incorporation equipment should be set to work the soil 10 cm deep with a disc operating at 6–10 km/hr or a vibrating shank cultivator at 10–13 km/hr; one incorporation is sufficient and need not be immediate. Rainfall within 10 days is required for maximum activity of the preemergence application. **Residual Activity:** Activity will normally be maintained for 10–14 weeks. **Unique Characteristics:** The rate required depends on weed pressure (higher rate for heavier weed pressure). Yellow nut sedge control requires a preplant incorporated application. Winter cereals may be planted 4–5 months after metolachlor application. Many tank-mix combinations are registered on various crops. Do not use on muck soils or coarse-textured soils low in organic matter. DUAL II MAGNUM contains benoxacor, a chemical that enhances the corn plant's ability to metabolize s-metolachlor, thereby preventing corn injury even under adverse environmental conditions.

S-METOLACHLOR/ATRAZINE

Trade Name: PRIMEXTRA II MAGNUM. **Chemical Family:** Acetanilide/s-triazine. **Crop and/or Non-Crop Registrations:** Corn (ensilage, field, seed and sweet). **Sensitive Weeds:** Germinating annual broadleaf weeds and annual grasses such as Amercian nightshade, eastern black nightshade, lady's-thumb, lamb's-quarters, wild mustard, purslane, prostrate pigweed, redroot pigweed, wild buckwheat, smartweed, ragweed, crab grass, barnyard grass, green foxtail, yellow foxtail, giant foxtail, witch grass and fall panicum. Yellow nut sedge can be controlled with a preplant incorporated application. **Uptake and Translocation:** Absorbed by germinating grasses mainly through shoot just above seed. Absorbed by germinating broadleaf weeds through roots and shoot. **Basis of Selectivity:** Metabolized by tolerant species. **Application Methods:** Early preplant, preplant incorporated, and preemergence. Early postemergence on corn (spike to 2–leaf stage of corn. Incorporation equipment should be set to work the soil 10 cm deep with a disc operating at 6–10 km/hr or a vibrating shank cultivator at 10–13 km/hr.). One incorporation is sufficient and need not be immediate. Rainfall within 10 days is required for maximum activity of the preemergence application. S-metolachlor/atrazine may be applied in nitrogen solutions or liquid fertilizers for preplant incorporated or preemergence weed control. Dry bulk granular fertilizers may be impregnated with metolachlor/atrazine for preplant incorporation. **Residual Activity:** Activity will normally be maintained for 10–14 weeks; late-germinating fall panicum will not be controlled. Soybeans, white beans, oats or barley may be planted the following spring. **Unique Characteristics:** The rate required depends on weed pressure (higher rate for heavier weed pressure. Yellow nut sedge control requires a preplant incorporated application. Will not control triazine-resistant weed species. Contains atrazine in low amounts, which may carry over in a dry year. Is effective over a wide range of soil types and has a good margin of crop safety. Perennial weeds are not controlled. Primextra II MAGNUM contains benoxacor, a chemical that enhances the corn plant's ability to metabolize s-metolachlor, thereby preventing corn injury even under adverse environmental conditions.

SETHOXYDIM

TRADE NAME: POAST ULTRA. **Chemical Family:** Cyclohexanedione. **Crop and/or Non-Crop Registrations:** Canola (rapeseed), flax, soybeans, dry beans, snap beans, peas, onions, tomatoes, potatoes, sweet potato, pumpkin, squash, cucumbers, alfalfa, lima beans, faba beans, adzuki beans, mung beans, buckwheat, creeping red fescue, garlic, broccoli, cabbage, cauliflower, peppermint, spearmint, apples, apricots, cherries, peaches, pears, plums, highbush

blueberries, cranberries, strawberries and sethoxydim-resistant corn. **Sensitive Weeds:** Annual grasses (wild oats, foxtails, barnyard grass, large crab grass, proso millet, fall panicum and witch grass), volunteer corn and cereals and quack grass. **Uptake and Translocation:** Absorbed by foliage. Translocated upwards and downwards in plant. **Basis of Selectivity:** Degraded by tolerant species (broadleaf plants). **Application Methods:** Postemergence to actively growing annual grasses in the 1– to 6–leaf stage and quack grass in the 1– to 3–leaf stage. Use flat fan nozzles and add MERGE adjuvant to the spray mix. Alternatively, ASSIST OIL CONCENTRATE or Ammonium sulphate plus ASSIST OIL CONCENTRATE may be used. Other postemergence herbicides that are not recommended as tank-mix combinations on the label must be applied at least 4 days before or after sethoxydim application. Aerial application is also registered. **Residual Activity:** Essentially none. A second application and/or cultivation may be necessary to control grasses that emerge after treatment. **Unique Characteristics:** Susceptible grasses, when sprayed, stop growing immediately and then gradually turn yellow to purple to brown over a period of 7–21 days, depending on growing conditions and crop competition. Rainfall within 1 hour after application may reduce effectiveness. If treated grasses are stressed (drought, flooding, prolonged cool temperatures) control will be delayed or reduced.

SIMAZINE

Trade Names: PRINCEP NINE-T, SIMADEX, SIMAZINE, SIMAZINE 480. **Chemical Family:** S-triazine. **Crop and/or Non-Crop Registrations:** Corn, established asparagus, bird's-foot trefoil, raspberries, loganberries, blackberries, highbush blueberries, alfalfa, apples, apricots, cherries, peaches, pears and plums established for 1 year or more; grapes established for 3 or more years; shelterbelts established for at least one growing season (caragana, green ash, Siberian elm, American elm and Manitoba maple); new or established Christmas tree and woodland plantations (2 yr or older white pine and balsam fir); woody ornamentals and nursery stock established for at least 1 yr (cedar, barberry, apple, flowering crab apple, box wood, cotoneaster, dogwood, holly, rose, yews, chamaecyparis, hemlock, juniper, multiflora rose, peony; spruce, mugho pine, black walnut and white ash); nursery container stock (cedar, juniper, yew); aquatic weed control; non-crop land. Conifer site preparation before planting of fir, pine and spruce (Princep Nine-T only). **Sensitive Weeds:** Annual broadleaf weeds such as pigweed, lady's-thumb, lamb's-quarters, purslane, ragweed, volunteer clover, wild buckwheat, smartweed, plantain and groundsel; annual grasses such as barnyard grass, crab grass, wild oats and yellow foxtail (triazine-resistant biotypes of foxtail, lamb's-quarters, pigweed and groundsel will not be controlled); most perennial species starting freshly from seed. **Uptake and Translocation:** Absorbed by roots; little or no foliar absorption; translocated upwards in xylem, accumulating in apical meristem and leaves with napropamide on new plantings of apples, apricot, cherries, plums, peaches and pears. **Basis of Selectivity:** Some species, such as corn, metabolize simazine. In most crops, selectivity is based on the roots of the crop plants being deeper than the depth to which simazine leaches. **Application Methods:** Preplant incorporated (to a depth of 2.5 cm) or preemergence in corn; preemergence in other crops. Broadcast or band application. In fruit crops, apply a 1 m wide band under the plants; cultivate or sod the area between the rows. For aquatic weed control, apply as a draw-down treatment or water-volume application in drainage ditches and ponds with no water flow-through. **Residual Activity:** Soil residues may persist for more than 1 season. After spraying with simazine, do not plant any crop in the treated area in the same year except corn. Where rates in excess of 2 kg/ha have been applied, do not plant rotational crops in the following year; soils should be tested if there is any question of excessive residues remaining. **Unique Characteristics:** Needs sufficient moisture to be activated. Should be applied only once per season. To avoid build-up of resistant weeds, simazine should be rotated with other non-triazine residual herbicides. Simazine is more persistant than atrazine. Where rainfall is sufficient to cause erosion, soil containing simazine may wash to lower areas of land and injure existing or subsequent crops.

SURFACTANT

See Chapter 5, Notes on Adjuvants.

TERBACIL

Trade Name: SINBAR. **Chemical Family:** Uracil. **Crop and/or Non-Crop Registrations:** apples, apricots, cherries, highbush blueberries, peaches, pears, plums, spearmint, peppermint, and strawberries; with napropamide on new plantings of apples, apricots, cherries, plums, peaches and pears. **Sensitive Weeds:** Barnyard grass, bluegrass, crab grass, foxtail, chickweed, cheat grass, perennial rye grass, wild barley, mustard, prickly lettuce, stinkweed, annual sow-thistle, henbit, lamb's-quarters, pigweed, purslane and ragweed. Partial control of quack grass, horsenettle, vetch and yellow nut sedge. **Uptake and Translocation:** Uptake is mostly through roots, although partially through foliage and stem. Translocation is upward into leaves. **Basis of Selectivity:** Used only on established plantings so that roots of crop are below depth to which chemical penetrates. May also be slower translocation and faster degradation in tolerant species. **Application Methods:** Apply to the soil surface in 200–1000 L water/ha. If weed growth is present in apples, paraquat may be mixed with spray. Rates for strawberries are considerably lower and can be applied in spring, post-harvest or late fall. Control of perennial grasses may be improved by cultivation prior to treatment. **Residual Activity:** May be up to 2 yr. Residues are likely to be higher on heavier soil types if higher rates and repeated applications are used. **Unique Characteristics:** Moisture is necessary to activate the chemical within 2 weeks after application. Do not apply on soils with less than 1% organic matter, nor on eroded soil areas. Use lower rates on soils with 1%–2% organic matter. Do not apply on weak or diseased strawberry plants.

THIFENSULFURON-METHYL

Trade Name: PINNACLE. **Chemical Family:** Sulfonyl urea. **Crop and/or Non-Crop Registrations:** Soybeans. **Sensitive Weeds:** Redroot pigweed, lamb's-quarters, velvetleaf, lady's-thumb and wild mustard. **Uptake and Translocation:** Following foliar application, the herbicide is rapidly absorbed and translocated in both the xylem and phloem to growing points of sensitive weeds. **Basis of Selectivity:** Inhibition of acetolactase synthase (ALS) enzyme in susceptible plants that leads to a rapid cessation of cell division and plant growth. Tolerant species rapidly metabolize the herbicide into non-phytotoxic metabolites. **Application Method:** Postemergence. **Residual Activity:** Rapid soil microbial degradation. Half-life of 5 days at 25°C soil temperatures. **Unique Characteristics**: Labelled species can be controlled up to 10 cm in height. Redroot pigweed is very sensitive. Typical symptoms of plant death (leaf crinkling, curling, chlorosis) occur 5–10 days after application depending on the growing conditions. Velvetleaf control is greatly enhanced by the inclusion of ammonium containing fertilizer (such as a UAN solution).

THIFENSULFURON-METHYL/ TRIBENURON-METHYL

Trade Name: REFINE EXTRA. **Chemical Family:** Sulfonyl urea. **Crop and/or Non-Crop Registrations:** Wheat (spring,winter, durum), barley, oats not underseeded to legumes or grasses. **Sensitive Weeds:** Lamb's-quarters, annual smartweed (green smartweed, lady's-thumb), chickweed, hemp-nettle, wild buckwheat, cow cockle, stinkweed, Canada thistle, sow-thistle, round-leaved mallow. **Uptake and Translocation:** Following foliar application, is rapidly absorbed and translocated in both xylem and phloem. **Basis of Selectivity:** Inhibition of acetolactate synthase in susceptible plants leads to a rapid cessation of cell division and growth. Tolerant species rapidly convert to non-phytotoxic metabolites. **Application Method:** Postemergence. **Residual Activity:** Rapid soil microbial degradation. **Unique Characteristics:** A non-ionic surfactant must be added. Typical symptoms of plant death (leaf crinkling, curling, chlorosis) occur 5–10 days after application depending on growing conditions. Tank-mixes with MCPA and 2,4-D for control of ragweed and mustards.

TRALKOXYDIM

Trade Name: ACHIEVE 80DG. **Chemical Family:** Cyclohexanedione. **Crop and/or Non-Crop Registrations**: Spring wheat, spring barley. **Sensitive Weeds:** Wild oats. **Uptake and Translocation**: Uptake through the leaves, translocated to growing points of roots, shoots and leaves. **Basis of Selectivity:** Metabolized in tolerant species. **Application Methods:** Postemergence to actively growing wild oats at 1– to 5–leaf stage. Rainfast in 1 hour. **Residual Activity:** none. **Unique Characteristics:** Safe on all varieties of spring wheat and barley. May be applied to cereal crops underseeded to legumes such as clover, alfalfa, sainfoil or bird's-foot trefoil. Do not feed or graze forage in year of treatment.

TRIALLATE

Trade Name: AVADEX BW **Chemical Family:** Thiocarbamate. **Crop and/or Non-Crop Registrations:** Spring wheat and barley, flax, rapeseed, sugar beets, mustard and dry peas. **Sensitive Weeds:** Wild oats. **Uptake and Translocation:** Absorbed mainly by the coleoptile of wild oats. **Application Methods:** Postplant incorporated (spring wheat and barley). Preplant incorporated (barley, flax, rapeseed, sugar beets, mustard and dry peas). For postplant treatment of the cereals, the spray is applied to the soil after the crop is seeded and then thoroughly worked into the soil by harrowing twice, the second harrowing at right angles to the first; the crop should be seeded uniformly, deep enough so it is not disturbed by the harrow. For preplanting treatments, the chemical is sprayed on the soil surface and worked into the top 5–8 cm of soil with a disk or cultivator implement. The crop can be seeded anytime after treatment. In all treatments, the chemical should be worked into the soil within 2 hr. after spraying. **Residual Activity:** Half-life in soil of approximately 6–8 weeks.

TRICLOPYR

Trade Name: GARLON 4, RELEASE. **Chemical Family:** Pyridine. **Non-Crop Registrations:** GARLON 4—site preparation for lowbush blueberry, and the control of unwanted woody plants and annual and perennial broadleaf weeds in non-crop areas including rights-of-way, electrical power lines, communication lines, pipelines, roadsides and manufacturing and storage sites. RELEASE silvicultural herbicide is recommended for the control of undesirable woody plants and annual and perennial broadleaf weeds in woodland management. **Sensitive Weeds:** Woody plant species controlled are: alder, ash, aspen, basswood, beech, birch, blackberry, raspberry, buckthorn, cottonwood, dogwood, elderberry, hawthorn, hickory, hop-hornbeam, locust, maples, mulberry, poison-oak, poplar, sumac, willow, honey locust, choke cherry, elm, red maple, oaks and pines. Annual and broadleaf weeds controlled are: burdock, chicory, curled dock, dandelion, field bindweed, lamb's-quarters, ragweed, smartweed, smooth bedstraw, vetch and wild lettuce. **Uptake and Translocation:** Triclopyr is absorbed by both plant leaves and roots. It is readily translocated through plants. It tends to accumulate in meristematic tissues and is not readily metabolized in susceptible plants. **Basis of Selectivity:** Tolerant species such as grasses rapidly metabolize triclopyr. **Application Methods:** For deciduous and certain conifer species use as a foliage spray when brush species are actively growing. Apply either broadcast using a fixed nozzle (constant volume per ha) or selectively using a spray gun (variable volume per ha). As spray gun applications use a dilute spray mix, this type of application must thoroughly wet the foliage, stem and root collar. Brush should be treated after foliage is well developed and actively growing. For conifer release in woodland sites, application should be made in late summer after conifers have hardened off and deciduous trees are in full leaf but prior to autumn coloration. Woody plants

may also be controlled by using basal bark, dormant stem and cut-surface treatments. **Residual Activity:** Half-life in soil is approximately 30 days under conditions that are favourable for microbial decomposition. **Unique Characterisitics**: Applications should be made only when there is little or no hazard from spray drift. Small quantities of spray drift may injure susceptible broadleaf plants.

TRIFLURALIN

Trade Names: BONANZA 400, RIVAL, TREFLAN EC. **Chemical Family:** Dinitroaniline. **Crop and/or Non-Crop Registrations:** Soybeans, dry beans (white or kidney), faba beans, snap beans, lima beans, black beans, canola (rapeseed), triazine-tolerant canola (variety of O.A.C. Triton, pedigreed seed only), sunflowers, turnips, peas (field and canning), direct-seeded alfalfa; transplants of tomatoes, peppers, Brussels sprouts, broccoli, cabbage and cauliflower; carrots, crambe, direct-seeded cabbage and cauliflower, annual flowers, woody ornamental plantings and field-grown nursery stock, perennials, established shelterbelts, strawberries. **Sensitive Weeds:** Effective on most annual grasses, and will provide good control of pigweed and lamb's-quarters, including the triazine-tolerant biotypes of these weeds. **Uptake and Translocation:** No significant absorption or translocation of trifluralin in crops grown in soil treated with trifluralin. Susceptible weeds are controlled as they germinate. Established weeds are not controlled. **Basis of Selectivity:** Physiological growth processes associated with seed germination. **Application Methods:** Preplant incorporated. Apply in 100–300 L of water/ha. Use lower rate of the chemical on sandy soils and increased rate for loam-to-clay soils. Do not use on highly organic soils (muck, peat or black sands above 15% organic matter). Incorporate twice in cross directions using a tandem disc (7–10 km/hr) or tine cultivator (10–13 km/hr) set to work 8–10 cm deep. The first incorporation should be done as soon as possible after application, but may be delayed 8–24 hr., depending on label directions. The second incorporation is recommended anytime before planting. Activated upon incorporation; rainfall is not required. **Residual Activity:** Recommended application rates provide season-long weed control. Succeeding crops, even fall-seeded grain crops planted in soil that received trifluralin the preceding spring, will not be injured under normal conditions. **Unique Characteristics:** Strongly adsorbed to soil particles and shows negligible leaching. Organic matter and clay content influence application rate. Does not control ragweed, annual nightshades or mustards; lady's-thumb may escape.

TRIFLUSULFURON-METHYL

Trade Name: UPBEET. **Chemical Family:** Sulfonylurea. **Crop and/or Non Crop Registrations:** Sugar beets. With BETAMIX on sugar beets. **Sensitive Weeds:** Redroot and green pigweed, velvetleaf. **Uptake And Translocation:** Following foliar application, the herbicide is rapidly absorbed and translocated in both the xylem and phloem to growing points of sensitive weeds. **Basis of Selectivity:** Inhibition of acetolactase synthase (ALS) enzyme in susceptible plants that leads to a rapid cessation of cell division and plant growth. Tolerant species rapidly metabolize the herbicide into non-phytotoxic metabolites. **Application Methods:** postemergence. **Residual Activity:** None. **Unique Characteristics**: Must be applied with an approved adjuvant system including 0.2% v/v non-ionic surfactant. Addition of 28% urea ammonium nitrate (U.A.N.) at 2 L/ha will improve weed control. Plant death of target weeds may take from 1–3 weeks for visual symptoms to develop. Symptoms develop more quickly under favourable growing conditions.

TABLE 1: Herbicides Used in Ontario - Abbreviations and column headings explained at end of table

2,4-D	2,4-D *	Sn	470 g/L	4	A	3	*
2,4-D	AMINE 500	EC	470 g/L	4	A	3	NUA
2,4-D	ESTASOL 600	EC	564 g/L	4	C	2	NUA
2,4-D	ESTASOL 700	EC	660 g/L	4	C	2	NUA
2,4-D	ESTEMINE 2,4-D	Sn	470 g/L	4	A	3	UAG
2,4-D	ESTER 600	EC	564 g/L	4	C	2	UAG
2,4-D	ESTER 700	EC	660 g/L	4	C	2	INT
2,4-D	IPCO 2,4-D AMINE 600	EC	564 g/L	4	C	2	INT
2,4-D	SAVAGE	DS	80%	4	C	4	UAG
2,4-D *	2,4-D	Sn	470 g/L	4	A	3	*
2,4-D/ dicamba/ mecoprop	KIL-MOR	Sn	485 g/L	4	A	2	SYN
2,4-D/ dicamba/ mecoprop	KILLEX	Sn	308 g/L	4	A	3	SYN
2,4-D/ dicamba/ mecoprep	KILLEX 500	Sn	479 g/L	4	A	3	SYN
2,4-D/ dicamba/ mecoprop	KILLEX SUMMER FORMULA	Sn	320 g/L	4	A	3	SYN
2,4-D/ dicamba/ mecoprop	PAR III	Sn	308 g/L	4	A	3	UAG
2,4-D/ dicamba/ mecoprop	PREMIUM 3-WAY TURF HERBICIDE	Sn	308 g/L	4	A	3	INT
2,4-DB	CALIBER 400	EC	400 g/L	4	B	2	UAG
2,4-DB	COBUTOX 600	EC	600 g/L	4	B	2	INT
2,4-DB	EMBUTOX 625	EC	625 g/L	4	B	2	NUA
AATREX	atrazine	Su	480 g/L	5	B	2	SYN
AATREX NINE-O	atrazine	WG	90 %	5	C	2	SYN
ACCENT	nicosulfuron	DF	75 %	2	C	2	DUQ
ACCENT 1-PASS	nicosulfuron + prosulfuron + dicamba	DF + WG + Sn	75 % + 75% + 480 g/L	2,4	C	2	DUQ
ACCLAIM SUPER	fenoxaprop-p-ethyl	EC	80.5 g/L	1	A	2	AET
ACHIEVE 80DG	tralkoxydim	DG	80 %	1	B	3	SYN
acifluorfen	BLAZER	Sn	240 g/L	14	B	2	BAZ
AFESIN	monolinuron	EC	200 g/L	7	D	3	AET
AFOLAN F	linuron	Su	480 g/L	7	A	3	AET
AGRICULTURAL WEED KILLER	mineral oil (herbicidal)	Li	100 %		C	6	VAR
ALANAP-3	naptalam	Sn	240 g/L	19	A	3	UNR
AMINE 500	2,4-D	EC	470 g/L	4	A	3	NUA
amitrole	AMITROL 240	SC	231 g/L	11	E	2	NUA
AMITROL 240	amitrole	SC	231 g/L	11	E	2	NUA
AQUASHADE	water soluble dyes	Li	26 %		A	2	APB
ARSENAL	imazapyr	Sn	240 g/L	2	B	2	BAZ
ASSURE II	quizalofop-p-ethyl	EC	96 g/L	1	A	2	DUQ

TABLE 1 Herbicides Used in Ontario (Abbreviations and column headings explained at end of table)

atrazine	AATREX	Su	480 g/L	5	B	2	SYN
atrazine	AATREX NINE-O	WG	90 %	5	C	2	SYN
atrazine	ATRAZINE 480	Su	480 g/L	5	B	2	UAG
atrazine	ATRAZINE 80W	WP	80 %	5	C	2	*
atrazine	ATRAZINE 90W	WP	90 %	5	C	2	*
atrazine	ATRAZINE 90WG	WG	90 %	5	C	2	UAG
ATRAZINE 480	atrazine	Su	480 g/L	5	B	2	UAG
ATRAZINE 80W	atrazine	WP	80 %	5	C	2	*
ATRAZINE 90W	atrazine	WP	90 %	5	C	2	*
ATRAZINE 90WG	atrazine	WG	90 %	5	C	2	UAG
atrazine/2,4-D	SHOTGUN	Su	390 g/L	4,5	A	2	UAG
AVADEX BW	triallate	EC	400 g/L	8	A	3	MOX
AVENGE 200C	difenzoquat	Sn	200 g/L	8	A	3	BAZ
AXIOM	flufenacet/metribuzin	DF	68%	5,15	C	2	BBB
BANVEL II	dicamba	Sn	480 g/L	4	B	2	BAZ
BASAGRAN	bentazon	Sn	480 g/L	6	B	3	BAZ
BASAGRAN FORTE	bentazon	Sn	480 g/L	6	A	3	BAZ
BASAMID	dazomet	Gr	98 %	27	C	2	BAZ
bensulide	BETASAN	EC	480 g/L	8	A	3	GOW
bensulide	BETASAN (GR)	Gr	12.5 %	8	C	3	GOW
bentazon	BASAGRAN	Sn	480 g/L	6	B	3	BAZ
bentazon	BASAGRAN FORTE	Sn	480 g/L	6	A	3	BAZ
bentazon/ atrazine	LADDOK	Su	(1:1) 400 g/L	5,6	A	2	BAZ
BETAMIX	desmedipham/phenmedipham	EC	(1:1) 150 g/L	7	B	2	AET
BETANEX	desmedipham	EC	150 g/L	7	B	3	AET
BETASAN	bensulide	EC	480 g/L	8	A	3	GOW
BETASAN (GR)	bensulide	Gr	12.5 %	8	C	3	GOW
BLADEX 90 DF	cyanazine	DF	90 %	5	C	2	DUQ
BLADEX LIQUID	cyanazine	Li	480 g/L	5	B	2	DUQ
BLAZER	acifluorfen	Sn	240 g/L	14	B	2	BAZ
BONANZA 400	trifluralin	EC	400 g/L	3	B	3	UAG
BOUNDARY	s-metolachlor + metribuzin	EC + Su	915 g/L + 500 g/L	5,15	B	2	SYN
BROADSTRIKE DUAL	flumetsulam/metolachlor	SC	923 g/L	2,15	C	2	DWE
BROADSTRIKE DUAL MAGNUM	flumetsulam/metolachlor	SC	924.7 g/L	2,15	C	2	DWE
BROADSTRIKE TREFLAN	flumetsulam/trifluralin	SC	438 g/L	2,3	A	2	DWE
bromacil	HYVAR X-L	Sn	240 g/L	5	C	2	DUQ
bromacil/ diuron	KROVAR	DF	(1:1) 80 %	5,7	C	2	DUQ
bromoxynil	KORIL	EC	235 g/L	6	C	2	NUA
bromoxynil	PARDNER	EC	280 g/L	6	C	2	AET

TABLE 1. Herbicides Used in Ontario (Abbreviations and column headings explained at end of table)

bromoxynil/ MCPA	BUCTRIL M	EC	(1:1) 560 g/L	4,6	C	2	AET
bromoxynil/ MCPA	MEXTROL	EC	(1:1) 400 g/L	4,6	C	2	NUA
BUCTRIL M	bromoxynil/ MCPA	EC	(1:1) 560 g/L	4,6	C	2	AET
CALIBER 400	2,4-DB	EC	400 g/L	4	B	2	UAG
CASORON 4G	dichlobenil	Gr	4 %	20	C	3	UNR
chlorimuron-ethyl	CLASSIC	DF	25 %	2	C	2	DUQ
chlorimuron-ethyl/ thifensulfuron-methyl	RELIANCE STS	DF	(1.75:1) 33 %	2	C	2	DUQ
chlorpropham	CIPC	Gr	20 %	23	C	2	STD
chlorpropham	CIPC EC	EC	480 g/L	23	-	2	STD
chlorpropham	CIPC GR	Gr	10 %	23	C	2	STD
clethodim	SELECT	EC	240 g/L	1	C	2	AET
clopyralid	LONTREL 360	Sn	360 g/L	4	A	2	DWE
clopyralid	TRANSLINE	Sn	360 g/L	4	A	2	DWE
clopyralid-methyl	FIRSTRATE	WG	84%	2	C	2	DWE
CLOVITOX PLUS	MCPB/MCPA	Sn	375+25	4	A	3	INT
COBUTOX 600	2,4-DB	EC	600 g/L	4	B	2	INT
COMPITOX	mecoprop	Sn	150 g/L	4	A	3	NUA
CONQUEST [1]	imazethapyr + metribuzin	WG	70% + 75%	2,5	C	2	BAZ
CONVERGE [1]	isoxaflutole + atrazine	WG+SC	75% + 480 g/L	5, 28	B	2	AET
CREDIT	glyphosate	Sn	356 g/L	9	B	6	NUA
copper ethanolamine	CUTRINE PLUS	Sn	9 %		A	2	APB
copper ethanolamine	CUTRINE PLUS (GRANULAR)	Gr	3.7 %		B	2	APB
CUTRINE PLUS	copper ethanolamine	Sn	9 %		A	2	APB
CUTRINE PLUS (GRANULAR)	copper ethanolamine	Gr	3.7 %		B	2	APB
cyanazine	BLADEX 90 DF	DF	90 %	5	C	2	DUQ
cyanazine	BLADEX LIQUID	Li	480 g/L	5	B	2	DUQ
cycloate	RO-NEET	EC	720 g/L	8	C	3	NOR
dinoseb	BASAMID	Gr	98 %	27	C	2	BAZ
dimethipin	BETANEX	EC	150 g/L	7	B	3	AET

TABLE 1. Herbicides Used in Ontario (Abbreviations and column headings explained at end of table)

desmedipham/phenmedipham	BETAMIX	EC	(1:1) 150 g/L	7	B	2	AET
DEVRINOL 10G	napropamide	Gr	10 %	15	C	3	UAG
DEVRINOL 50W	napropamide	WP	50 %	15	C	3	UAG
DEVRINOL DF	napropamide	DF	50 DF	15	C	3	UAG
dicamba	BANVEL II	Sn	480 g/L	4	B	2	BAZ
dicamba	VANQUISH	Sn	480 g/L	4	B	2	SYN
dicamba/ atrazine	MARKSMAN	Fl	(1:2) 401 g/L	4,5	B	2	BAZ
dicamba/ MCPA	DYVEL	Sn	(1:4) 420 g/L	4	B	2	BAZ
dicamba/ MCPA/ mecoprop	TARGET	Sn	400 g/L	4	A	3	SYN
dichlobenil	CASORON 4G	Gr	4 %	20	C	3	UNR
dichlorprop/ 2,4-D	DICHLORPROP D	EC	(1:1) 582 g/L	4	B	2	INT
dichlorprop/ 2,4-D	DIPHENOPROP BK 700	EC	679 g/L	4	B	2	UAG
dichlorprop/ 2,4-D	ESTAPROP	EC	582 g/L	4	B	2	NUA
dichlorprop/ 2,4-D	WEEDONE CB	Sn	(1:1) 160 g/L	4	C	2	NUA
DICHLORPROP D	dichlorprop/ 2,4-D	EC	(1:1) 582 g/L	4	B	2	INT
diclofop-methyl	HOE-GRASS 284	EC	284 g/L	1	A	3	AET
difenzoquat	AVENGE 200C	Sn	200 g/L	8	A	3	BAZ
diflufenzopyr/dicamba	DISTINCT	WG	70 %	4,19	C	2	BAZ
DIMENSION	dithiopyr	EC	120 g/L	3	B	2	DWE
dimethenamid	FRONTIER	EC	900 g/L	15	A	3	BAZ
DIPHENOPROP BK 700	dichlorprop/ 2,4-D	EC	679 g/L	4	B	2	UAG
diquat	REGLONE DESSICANT	Li	240 g/L	22	A	3	SYN
diquat (aquatic)	REWARD	Li	240 g/L	22	A	2	SYN
DISTINCT	diflufenzopyr/dicamba	WG	70 %	4,19	C	2	BAZ
dithiopyr	DIMENSION	EC	120 g/L	3	B	2	DWE
diuron	KARMEX	DF	80 %	7	C	2	GRN
DUAL II MAGNUM	s-metolachlor/benoxacor	EC	915 g/L	15	B	2	SYN
DUAL MAGNUM	s-metolachlor	EC	915 g/L	15	B	2	SYN
DYVEL	dicamba/ MCPA	Sn	(1:4) 420 g/L	4	B	2	BAZ
ELIM EP	rimsulfuron	DF	25 %	2	C	2	DUQ
EMBUTOX 625	2,4-DB	EC	625 g/L	4	B	2	NUA
endothall	HERBICIDE 273	Sn	360 g/L		A	2	EFA
EPTAM	EPTC	EC	800 g/L	8	C	3	SYN
EPTC	EPTAM	EC	800 g/L	8	C	3	SYN
EPTC/ R25788 (EPTC+)	ERADICANE	EC	800 g/L	8	C	2	NOR
ERADICANE	EPTC/ R25788 (EPTC+)	EC	800 g/L	8	C	2	NOR
ESTAPROP	dichlorprop/ 2,4-D	EC	582 g/L	4	B	2	NUA
ESTASOL 600	2,4-D	EC	564 g/L	4	C	2	NUA
ESTASOL 700	2,4-D	EC	660 g/L	4	C	2	NUA

TABLE 1 Herbicides Used in Ontario (Abbreviations and column headings explained at end of table)

ESTEMINE 2,4-D	2,4-D	Sn	470 g/L	4	A	3	UAG
ESTEMINE MCPA	MCPA	Sn	500 g/L	4	A	3	UAG
ESTER 600	2,4-D	EC	564 g/L	4	C	2	UAG
ESTER 700	2,4-D	EC	660 g/L	4	C	2	INT
ethametsulfuron-methyl	MUSTER	DF	75 %	2	C	5	DUQ
ethoxysulfuron	NORTRON SC	Su	480 g/L	16	A	2	AET
EVICT SOLUPAK 75DF	metribuzin	WG	75 %	5	C	2	UAG
EXCEL SUPER	fenoxaprop-p-ethyl	EC	80.5 g/L	1	A	2	AET
EXPEDITE BROADLEAF	mecoprop/ 2,4-D	Sn	(1:2) 186 g/L	4	A	2	PLG
EXPEDITE GRASS & WEED	glyphosate	Sn	147 g/L	9	A	3	MOX
EZJECT	glyphosate	P	0.15 g/capsule	9	C	3	MOX
fenoxaprop-p-ethyl	ACCLAIM SUPER	EC	80.5 g/L	1	A	2	AET
fenoxaprop-p-ethyl	EXCEL SUPER	EC	80.5 g/L	1	A	2	AET
FIELDSTAR	flumetsulam/clopyralid	WG	(1:2.7) 85.6 %	2,4	C	2	DWE
FIRSTRATE	cloransulam-methyl	WG	84%	2	C	2	DWE
fluazifop-p-butyl	FUSILADE II	EC	125 g/L	1	C	5	SYN
fluazifop-p-butyl	VENTURE 25G	DG	25 %	1	C	2	SYN
fluazifop-p-butyl	VENTURE L	EC	125 g/L	1	C	5	SYN
flufenacet/metribuzin	AXIOM	DF	68%	5,15	C	2	BBB
flumetsulam/clopyralid	FIELDSTAR	WG	(1:2.7) 85.6 %	2,4	C	2	DWE
flumetsulam/clopyralid/2,4-D	STRIKER	WG	(1:2.7:5.4) 84.3 %	2,4	C	2	DWE
flumetsulam/metolachlor	BROADSTRIKE DUAL	SC	923 g/L	2,15	C	2	DWE
flumetsulam/metolachlor	BROADSTRIKE DUAL MAGNUM	SC	924.7 g/L	2,15	C	2	DWE
flumetsulam/trifluralin	BROADSTRIKE TREFLAN	SC	438 g/L	2,3	A	2	DWE
fomesafen	REFLEX	Sn	240 g/L	14	B	2	SYN
fosamine ammonium	KRENITE	Sn	480 g/L	27	B	3	DUQ
FRONTIER	dimethenamid	EC	900 g/L	15	A	3	BAZ
FUSILADE II	fluazifop-p-butyl	EC	125 g/L	1	C	5	SYN
GALLERY	isoxaben	DF	75 %	21	C	2	DWE
GARLON 4	triclopyr	EC	480 g/L	4	B	2	DWE
GESAGARD 480 SC	prometryne	Su	480 g/L	5	B	2	SYN
glufosinate ammonium	IGNITE	Sn	150 g/L	10	A	3	AET
glufosinate ammonium	LIBERTY 200SN	Sn	200 g/L	10	A	3	AET
glufosinate ammonium + s-metolachlor/atrazine	LIBERTYPRIME	SN + SC	200 g/L + 720 g/L	5,10,15	A	2	SYN
GLYFOS	glyphosate	Sn	360 g/L	9	B	6	CAU
glyphosate	CLEAR-IT 1	Sn	7 g/L	9	B	4	MOX
glyphosate	CLEAR-IT 2	Sn	38 g/L	9	B	4	MOX
glyphosate	CLEAR-IT 3	Sn	143 g/L	9	B	4	MOX

TABLE 1. Herbicides Used in Ontario (Abbreviations and column headings explained at end of table)

glyphosate	CREDIT	Sn	356 g/L	9	B	6	NUA
glyphosate	EXPEDITE GRASS & WEED	Sn	147 g/L	9	A	3	MOX
glyphosate	EZJECT	P	0.15 g/capsule	9	C	3	MOX
glyphosate	GLYFOS	Sn	360 g/L	9	B	6	CAU
glyphosate	LAREDO	Sn	356 g/L	9	B	3	MOX
glyphosate	MAVERICK	Sn	356 g/L	9	B	6	DWE
glyphosate	RENEGADE	Sn	356 g/L	9	B	3	MOX
glyphosate	ROUNDUP	Sn	356 g/L	9	B	3	MOX
glyphosate	ROUNDUP DRY	SG	64 %	9	C	3	MOX
glyphosate	ROUNDUP L & G	Sn	assorted	9	B	4	MOX
glyphosate	ROUNDUP TRANSORB	Sn	360 g/L	9	B	6	MOX
glyphosate	VANTAGE	Sn	356 g/L	9	B	6	DWE
glyphosate	VANTAGE PLUS	Sn	360 g/L	9	B	6	DWE
glyphosate	VISION	Sn	356 g/L	9	B	2	MOX
glyphosate	WRANGLER	Sn	356 g/L	9	B	3	MOX
glyphosate TMS	TOUCHDOWN 480	Sn	330 g/L	9	B	6	SYN
glyphosate TMS	TOUCHDOWN 600	Sn	413 g/L	9	B	6	SYN
glyphosate/glufosinate ammonium	ROUNDUP FASTFORWARD	Sn	(18.75:1) 316 g/L	9,10	B	3	MOX
glyphosate/glufosinate ammonium	ROUNDUP FASTFORWARD PRESEED	Sn	(30:1) 310 g/L	9,10	B	3	MOX
GOAL 2XL	oxyfluorfen	EC	240 g/L	14	A	1	DWE
GRAMOXONE	paraquat	Sn	200 g/L	22	A	2	SYN
HERBICIDE 273	endothall	Sn	360 g/L		A	2	EFA
hexazinone	PRONONE	Gr	10 %	5	C	3	DUQ
hexazinone	VELPAR	SP	75 %	5	C	2	DUQ
HOE-GRASS 284	diclofop-methyl	EC	284 g/L	1	A	3	AET
HYVAR X-L	bromacil	Sn	240 g/L	5	C	2	DUQ
IGNITE	glufosinate ammonium	Sn	150 g/L	10	A	3	AET
imazamox + bentazon	MERIDIAN PLUS [1]	WG+Sn	70 % + 480 g/L	2,6	A	2	BAZ
imazamox + fomesafen	VIPER [1]	WG+Sn	70 % + 240 g/L	2,14	C	2	BAZ
imazapyr	ARSENAL	Sn	240 g/L	2	B	2	BAZ
imazethapyr	PURSUIT	Sn	240 g/L	2	A	2	BAZ
imazethapyr/atrazine	PATRIOT	SC	405 g/L	2,5	A	2	BAZ
imazethapyr/pendimethalin	VALOR	EC	(1:14.5) 342 g/L	2,3	A	5	BAZ
imazethapyr + bentazon	CLEANSWEEP [1]	Sn+Sn	240 g/L+480 g/L	2,6	A	2	BAZ
imazethapyr + metribuzin	CONQUEST [1]	WG+WG	70% + 75%	2,5	C	2	BAZ
isoxaben	GALLERY	DF	75 %	21	C	2	DWE
isoxaflutole	CONVERGE 75 WDG	WG	75%	28	B	2	AET
KARMEX	diuron	DF	80 %	7	C	2	GRN
KERB	propyzamide	WP	50 %	15	C	3	DWE

TABLE 1 Herbicides Used in Ontario (Abbreviations and column headings explained at end of table)

KILLEX	2,4-D/ dicamba/ mecoprop	Sn	308 g/L	3	A	2	SYN
KILLEX 500	2,4-D/ dicamba/ mecoprop	Sn	479 g/L	4	A	3	SYN
KILLEX SUMMER FORMULA	2,4-D/ dicamba/ mecoprop	Sn	320 g/L	4	A	3	SYN
KIL-MOR	2,4-D/ dicamba/ mecoprop	Sn	485 g/L	4	A	2	SYN
KORIL	bromoxynil	EC	235 g/L	6	C	2	NUA
KRENITE	fosamine ammonium	Sn	480 g/L	27	B	3	DUQ
KROVAR	bromacil/ diuron	DF	(1:1) 80 %	5,7	C	2	DUQ
LADDOK	bentazon/ atrazine	Su	(1:1) 400 g/L	5,6	A	2	BAZ
LAREDO	glyphosate	Sn	356 g/L	9	B	3	MOX
LENTAGRAN	pyridate	WP	45 %	6	A	3	SYN
LEXONE DF	metribuzin	DF	75 %	5	C	2	DUQ
LIBERTY 200SN	glufosinate ammonium	Sn	200 g/L	10	A	3	AET
LIBERTYPRIME	s-metolachlor/benoxacor/atrazine + glufosinate ammonium	SC + SN	400 g/L + 200 g/L	5,10,15	A	2	SYN
linuron	AFOLAN F	Su	480 g/L	7	A	3	AET
linuron	LINURON 480	Su	480 g/L	7	A	3	UAG
linuron	LOROX DF	DF	50 %	7	C	3	GRN
linuron	LOROX L	Su	480 g/L	7	A	3	GRN
LINURON 480	linuron	Su	480 g/L	7	A	3	UAG
LONTREL 360	clopyralid	Sn	360 g/L	4	A	2	DWE
LOROX DF	linuron	DF	50 %	7	C	3	GRN
LOROX L	linuron	Su	480 g/L	7	A	3	GRN
maleic hydrazide	ROYAL MH 60 SG	SG	60 %		C	3	UNR
MARKSMAN	dicamba/ atrazine	Fl	(1:2) 401 g/L	4,5	B	2	BAZ
MAVERICK	glyphosate	Sn	356 g/L	9	B	6	DWE
MCPA	ESTEMINE MCPA	Sn	500 g/L	4	A	3	UAG
MCPA	MCPA AMINE	Sn	500 g/L	4	A	3	•
MCPA	MCPA ESTER	Sn	500 g/L	4	B	1	•
MCPA	MCPA SODIUM 300	Sn	300 g/L	4	A	3	•
MCPA AMINE	MCPA	Sn	500 g/L	4	A	3	•
MCPA ESTER	MCPA	Sn	500 g/L	4	B	1	•
MCPA SODIUM 300	MCPA	Sn	300 g/L	4	A	3	•
MCPA/mecoprop/dicamba	SWORD	Sn	(4.4:1:1) 400 g/L	4	A	3	UAG
MCPB/MCPA	CLOVITOX PLUS	Sn	375+25	4	A	3	INT
MCPB/MCPA	TROPOTOX PLUS	Sn	400 g/L	4	A	3	NUA
MECO-D	mecoprop/ 2,4-D	Sn	(1:1.9) 435 g/L	4	A	3	SGF
mecoprop	COMPITOX	Sn	150 g/L	4	A	3	NUA
mecoprop	MECOPROP	Sn	150 g/L	4	A	3	UAG
mecoprop	MECOPROP	Sn	assorted	4	A	3	•

TABLE 1. Herbicides Used in Ontario (Abbreviations and column headings explained at end of table)

MECOPROP	mecoprop	Sn	assorted	4	A	3	*
MECOPROP	mecoprop	Sn	150 g/L	4	A	3	UAG
MECOPROP PLUS 2,4-D	mecoprop/ 2,4-D	Sn	(0.9:1) 194 g/L	4	A	3	UAG
mecoprop/ 2,4-D	EXPEDITE BROADLEAF	Sn	(1:2) 186 g/L	4	A	2	PLG
mecoprop/ 2,4-D	MECO-D	Sn	(1:1.9) 435 g/L	4	A	3	SGF
mecoprop/ 2,4-D	MECOPROP PLUS 2,4-D	Sn	(0.9:1) 194 g/L	4	A	3	UAG
mecoprop/ 2,4-D	MECOTURF PLUS 2,4-D	Sn	(1:1) 400 g/L	4	A	3	NUA
mecoprop/ 2,4-D	PREMIUM 2-WAY TURF HERBICIDE	Sn	(1:1) 400 g/L	4	A	3	INT
mecoprop/ 2,4-D	TURF-RITE 2+2	Sn	(1:1) 400 g/L	4	A	3	SAF
MECOTURF PLUS 2,4-D	mecoprop/ 2,4-D	Sn	(1:1) 400 g/L	4	A	3	NUA
MERIDIAN PLUS [1]	imazamox + bentazon	WG+Sn	70 % + 480 g/L	2,6	A	2	BAZ
metam sodium	VAPAM	Sn	380 g/L	27	C	3	UAG
methyl bromide/ chloropicrin	TERR-O-GAS 67	Li	67% + 31%		-	1	GRC
metobromuron	PATORAN FL	Su	400 g/L	7	A	2	SYN
metribuzin	EVICT SOLUPAK 75DF	WG	75 %	5	C	2	UAG
metribuzin	LEXONE DF	DF	75 %	5	C	2	DUQ
metribuzin	SENCOR 500 F	Su	500 g/L	5	C	2	BBB
metribuzin	SENCOR 75 DF	WG	75 %	5	C	2	BBB
metribuzin	SENCOR SOLUPAK	WG	75 %	5	C	2	BBB
MEXTROL	bromoxynil/ MCPA	EC	(1:1) 400 g/L	4,6	C	2	NUA
mineral oil (herbicidal)	AGRICULTURAL WEED KILLER #1	Li	100 %		C	6	VAR
monolinuron	AFESIN	EC	200 g/L	7	D	3	AET
MUSTER	ethametsulfuron-methyl	DF	75 %	2	C	5	DUQ
napropamide	DEVRINOL 10G	Gr	10 %	15	C	3	UAG
napropamide	DEVRINOL 50W	WP	50 %	15	C	3	UAG
napropamide	DEVRINOL DF	DF	50 DF	15	C	3	UAG
naptalam	ALANAP-3	Sn	240 g/L	19	A	3	UNR
nicosulfuron	ACCENT	DF	75 %	2	C	2	DUQ
nicosulfuron + prosulfuron + dicamba	ACCENT 1-PASS	DF + WG + Sn	75 % + 75% + 480 g/L	2,4	C	2	DUQ
nicosulfuron/rimsulfuron	ULTIM DF	DF	(1:1) 37.4 %	2	C	2	DUQ
nicosulfuron/rimsulfuron	ULTIM 75DF	DF	(1:1) 75 %	2	C	2	DUQ
nicosulfuron/rimsulfuron + flumetsulam/clopyralid/2,4-D	ULTIMAX [1]	WG + WG	37.4% + 84.3%	2,4	C	2	DUQ
NORTRON SC	ethofumesate	Su	480 g/L	16	A	2	AET
oxadiazon	RONSTAR 2G	Gr	2 %	14	C	2	AET
oxyfluorfen	GOAL 2XL	EC	240 g/L	14	A	1	DWE
PAR III	2,4-D/ dicamba/ mecoprop	Sn	308 g/L	4	A	3	UAG
paraquat	GRAMOXONE	Sn	200 g/L	22	A	2	SYN

TABLE 1. Herbicides Used in Ontario (Abbreviations and column headings explained at end of table)

paraquat/ diquat	WEED AND GRASS KILLER	SG	(1:1) 5 %	22	C	3	NUG
PARDNER	bromoxynil	EC	280 g/L	6	C	2	AET
PATORAN FL	metobromuron	Su	400 g/L	7	A	2	SYN
PATRIOT	imazethapyr/atrazine	SC	405 g/L	2,5	A	2	BAZ
PEAKPLUS [1]	prosulfuron + dicamba	WG+Sn	75 % + 480 g/L	2,4	C	2	SYN
pendimethalin	PROWL 400	EC	400 g/L	3	A	5	BAZ
phenmedipham	SPIN-AID	EC	150 g/L	7	C	3	AET
picloram/ 2,4-D	TORDON 101	Sn	(1:3.7) 305 g/L	4	A	2	DWE
PINNACLE	thifensulfuron- methyl	DF	75 %	2	C	3	DUQ
POAST ULTRA	sethoxydim	EC	450 g/L	1	B	3	BAZ
PREMIUM 2-WAY TURF HERBICIDE	mecoprop/ 2,4-D	Sn	(1:1) 400 g/L	4	A	3	INT
PREMIUM 3-WAY TURF HERBICIDE	2,4-D/ dicamba/ mecoprop	Sn	308 g/L	4	A	3	INT
PRIMEXTRA II MAGNUM	s-metolachlor/benoxacor/atrazine	SC	(1:0.8) 720 g/L	5,15	B	2	SYN
primisulfuron-methyl/dicamba	SUMMIT	WG	(1:5.3) 47.4%	2,4	C	2	SYN
PRINCEP NINE-T	simazine	WG	90 %	5	C	2	SYN
PRISM	rimsulfuron	DF	25 %	2	C	2	DUQ
prometryne	GESAGARD 480 SC	Su	480 g/L	5	B	2	SYN
PRONONE	hexazinone	Gr	10 %	5	C	3	DUQ
propanil/ MCPA	STAMPEDE CM	EC	(3.6:1) 460 g/L	4,7	B	2	DWE
propyzamide	KERB	WP	50 %	15	C	3	DWE
prosulfuron + dicamba	PEAKPLUS [1]	WG+Sn	75 % + 480 g/L	2,4	C	2	SYN
PROWL 400	pendimethalin	EC	400 g/L	3	A	5	BAZ
PURSUIT	imazethapyr	Sn	240 g/L	2	A	2	BAZ
PYRAMIN FL	pyrazon	Su	430 g/L	5	B	3	BAZ
pyrazon	PYRAMIN FL	Su	430 g/L	5	B	3	BAZ
pyridate	LENTAGRAN	WP	45 %	6	A	3	SYN
quizalofop-p-ethyl	ASSURE II	EC	96 g/L	1	A	2	DUQ
REFINE EXTRA	thifensulfuron-methyl/ tribenuron-methyl	DF	(2:1) 75 %	2	C	2	DUQ
REFLEX	fomesafen	Sn	240 g/L	14	B	2	SYN
REGLONE DESSICANT	diquat	Li	240 g/L	22	A	3	SYN
REWARD	diquat (aquatic)	Li	240 g/L	22	A	2	SYN
RELEASE	triclopyr	EC	480 g/L	4	B	2	DWE
RELIANCE STS	chlorimuron-ethyl/ thifensulfuron-methyl	DF	(1.75:1) 33 %	2	C	2	DUQ
RENEGADE	glyphosate	Sn	356 g/L	9	B	3	MOX
rimsulfuron	ELIM EP	DF	25 %	2	C	2	DUQ
rimsulfuron	PRISM	DF	25 %	2	C	2	DUQ
RIVAL	trifluralin	EC	500 g/L	3	A	3	AET

TABLE 1. Herbicides Used in Ontario (Abbreviations and column headings explained at end of table)

RO-NEET	cycloate	EC	720 g/L	8	C	3	NOR
RONSTAR 2G	oxadiazon	Gr	2 %	14	C	2	AET
ROUNDUP	glyphosate	Sn	356 g/L	9	B	3	MOX
ROUNDUP DRY	glyphosate	SG	64 %	9	C	3	MOX
ROUNDUP FASTFORWARD	glyphosate/glufosinate ammonium	Sn	(18.75:1) 316 g/L	9,10	B	3	MOX
PREHARVEST							
ROUNDUP FASTFORWARD	glyphosate/glufosinate ammonium	Sn	(30:1) 310 g/L	9,10	B	3	MOX
PRESEED							
ROUNDUP L & G	glyphosate	Sn	assorted	9	B	4	MOX
ROUNDUP TRANSORB	glyphosate	Sn	360 g/L	9	B	3	MOX
ROYAL MH 60 SG	maleic hydrazide	SG	60 %		C	3	UNR
s-metolachlor	DUAL MAGNUM	EC	915 g/L	15	B	2	SYN
s-metolachlor/benoxacor	DUAL II MAGNUM	EC	915 g/L	15	B	2	SYN
s-metolachlor/benoxacor/atrazine	PRIMEXTRA II MAGNUM	SC	(1:0.8) 720 g/L	5,15	B	2	SYN
s-metolachlor + metribuzin	BOUNDARY	EC + Su	915 g/L + 500 g/L	5,15	B	2	SYN
SAVAGE	2,4-D	DS	80%	4	C	4	UAG
SELECT	clethodim	EC	240 g/L	1	C	2	AET
SENCOR 500 F	metribuzin	Su	500 g/L	5	C	2	BBB
SENCOR 75 DF	metribuzin	WG	75 %	5	C	2	BBB
SENCOR SOLUPAK	metribuzin	WG	75 %	5	C	2	BBB
sethoxydim	POAST ULTRA	EC	450 g/L	1	B	3	BAZ
SHOTGUN	atrazine/2,4-D	Su	390 g/L	4,5	A	2	UAG
SIMADEX	simazine	Su	500 g/L	5	A	2	AET
simazine	PRINCEP NINE-T	WG	90 %	5	C	2	SYN
simazine	SIMADEX	Su	500 g/L	5	A	2	AET
simazine	SIMAZINE 480	Su	480 g/L	5	A	2	UAG
simazine	SIMAZINE 80W	WP	80 %	5	C	2	UAG
SIMAZINE 480	simazine	Su	480 g/L	5	A	2	UAG
SIMAZINE 80W	simazine	WP	80 %	5	C	2	UAG
SINBAR	terbacil	WP	80 %	5	C	2	DUQ
SPIN-AID	phenmedipham	EC	150 g/L	7	C	3	AET
STAMPEDE CM	propanil/ MCPA	EC	(3.6:1) 460 g/L	4,7	B	2	DWE
STRIKER	flumetsulam/clopyralid/2,4-D	WG	(1:2.7:5.4) 84.3 %	2,4	C	2	DWE
SUMMIT	primisulfuron-methyl/dicamba	WG	(1:5.3) 47.4%	2,4	C	2	SYN
SWORD	MCPA/mecoprop/dicamba	Sn	(4.4:1:1) 400 g/L	4	A	3	UAG
TARGET	dicamba/ MCPA/ mecoprop	Sn	400 g/L	4	A	3	SYN
TELAR	chlorsulfuron	DF	75 %	2	C	2	DUQ
terbacil	SINBAR	WP	80 %	5	C	2	DUQ
TERR-O-GAS 67	methyl bromide/ chloropicrin	Li	67% + 31%			1	GRC

TABLE 1 Herbicides Used in Ontario (Abbreviations and column headings explained at end of table)

thifensulfuron- methyl	PINNACLE	DF	75 %	2	C	3	DUQ
thifensulfuron-methyl/ tribenuron-methyl	REFINE EXTRA	DF	(2:1) 75 %	2	C	2	DUQ
TORDON 101	picloram/ 2,4-D	Sn	(1:3.7) 305 g/L	4	A	2	DWE
TOUCHDOWN 480	glyphosate TMS	Sn	330 g/L	9	B	6	SYN
TOUCHDOWN 600	glyphosate TMS	Sn	413 g/L	9	B	6	SYN
tralkoxydim	ACHIEVE 80DG	DG	80 %	1	B	3	SYN
TRANSLINE	clopyralid	Sn	360 g/L	4	A	2	DWE
TREFLAN EC	trifluralin	EC	480 g/L	3	A	3	DWE
triallate	AVADEX BW	EC	400 g/L	8	A	3	MOX
triclopyr	GARLON 4	EC	480 g/L	4	B	2	DWE
triclopyr	RELEASE	EC	480 g/L	4	B	2	DWE
trifluralin	BONANZA 400	EC	400 g/L	3	B	3	UAG
trifluralin	RIVAL	EC	500 g/L	3	A	3	AET
trifluralin	TREFLAN EC	EC	480 g/L	3	A	3	DWE
triflusulfuron-methyl	UPBEET	DF	50 %	2	C	2	DUQ
TROPOTOX PLUS	MCPB/MCPA	Sn	400 g/L	4	A	3	NUA
TURF-RITE 2+2	mecoprop/ 2,4-D	Sn	(1:1) 400 g/L	4	A	3	SAF
ULTIM DF	nicosulfuron/rimsulfuron	DF	(1:1) 37.4 %	2	C	2	DUQ
ULTIM 75DF	nicosulfuron/rimsulfuron	DF	(1:1) 75 %	2	C	2	DUQ
ULTIMAX [1]	nicosulfuron/rimsulfuron + flumetsulam/clopyralid/2,4-D	WG+WG	37.4% + 84.3%	2,4	C	2	DUQ
UPBEET	triflusulfuron-methyl	DF	50 %	2	C	2	DUQ
VALOR	imazethapyr/pendimethalin	EC	(1:14.5) 342 g/L	2,3	A	5	BAZ
VAPAM	metam sodium	Sn	380 g/L	27	C	3	UAG
VANQUISH	dicamba	Sn	480 g/L	4	B	2	SYN
VANTAGE PLUS	glyphosate	Sn	360 g/L	9	B	6	DWE
VELPAR	hexazinone	SP	75 %	5	C	2	DUQ
VENTURE 25G	fluazifop-p-butyl	DG	25 %	1	C	2	SYN
VENTURE L	fluazifop-p-butyl	EC	125 g/L	1	C	5	SYN
VIPER [1]	imazamox + fomesafen	WG+Sn	70 % + 240 g/L	2,14	C	2	BAZ
VISION	glyphosate	Sn	356 g/L	9	B	2	MOX
water soluble dyes	AQUASHADE	Li	26 %		A	2	APB
WEED AND GRASS KILLER	paraquat/diquat	SG	(1:1) 5 %	22	C	3	NUG
WEEDONE CB	dichlorprop/2,4-D	Sn	(1:1) 160 g/L	4	C	2	NUA
WRANGLER	glyphosate	Sn	356 g/L	9	B	3	MOX

Table 1. Footnotes and Endnotes

Mention of a Brand or Trade name in this table does not constitute a guarantee or warrantee of the product by the Ontario Weed Committee. Neither does this use signify that that these products are approved to the exclusion of the comparable products. All trade names are capitalized.

* Various manufacturers.
1 indicates herbicides sold as a co-pack under this Trade name

Formulation Abbreviations

DC = dispersible concentrate
DF = dry flowable
DG = dry granules
DS = dry soluble
EC = emulsifiable concentrate
EM = emulsion
Fl = flowable
Gi = gel
Gr = granular
Li = liquid
P = paste
PE = pellets
PS = pressurized spray
SC = soluble concentrate
SG = soluble granules
Sn = solution
SP = soluble powder
WG = wettable granules
WP = wettable powder
Su = suspension (flowable)

Winter Storage

A — Do not allow to freeze.
B — Preferably should not freeze. If frozen, return to original state by allowing product to warm to 10°C–20°C and agitate thoroughly before use.
C — Not usually damaged by freezing. Store in a cool, dry place.
D — Do not allow to freeze — store above 10°C (this applies to AFESIN)
E — Do not allow to freeze — store above 4°C (this applies to the AMITROL 240)
READ STORAGE SECTION IN THE FRONT OF THIS PUBLICATION

Criteria for Ontario Classification of Pesticide Products

Sch.	Pesticide Category	Criteria	Sales Outlet	Used By
1	Restricted	Extremely Toxic, Very Highly Persistent	Licensed, Record of Sale	Licensed Applicator, Certified Agriculturist, under Permit Approval
5	Agriculture	Extremely Toxic, Very Highly Persistent	Licensed, Record of Sale	Same as Schedule 1 except no permit if Certified Agriculturist or Licensed Applicator
2	Pest Control Industry and Agriculture	Very Toxic, Highly Persistent	Licensed, Record of Sale	Licensed Applicator or Certified Agriculturist
3	Consumer, Pest Control Industry and Agriculture	Moderately Toxic, Moderately Persistent	Licensed	Homeowner, Licensed Applicator and Agriculturist
4	Consumer, Pest Control Industry and Agriculture	Slightly Toxic	No License Required	Homeowner, Licensed Applicator and Agriculturist
6	Consumer, Pest Control Industry, Commercial and Agriculture	Slightly Toxic	Licensed (same as Schedule 4 except larger container)	Homeowner, Licensed Applicator and Agriculturist

Manufacturer Agent Code

See HERBICIDE COMPANIES AND AGENTS on the last page of this publication. Phones numbers and Web sites are also listed.

TABLE 2. Herbicide Crop Rotation and Soil pH Restrictions

(For other crops, consult the label.)

Field Crops

	ALFALFA	BARLEY	BARLEY (UNDERSEEDED)	BEANS, KIDNEY	BEANS, WHITE	CANOLA INCLUDING RR	CANOLA, IMI SMART	CLOVER, RED	CORN, FIELD INCLUDING RR, LL, PP	CORN, CLEARFIELD	CORN, SEED	FLAX—LINSEED	OATS	OATS (UNDERSEEDED)	PEANUTS	RYE, FALL	RYE, FALL (UNDERSEEDED)	SOYBEANS	SUNFLOWERS	TOBACCO	WHEAT, SPRING	WHEAT, SPRING (UNDERSEEDED)	WHEAT, WINTER	WHEAT, WINTER UNDERSEEDED
	Number of months between application and planting																							
ACCENT	10	10	10	f	10	10	10	10	—	—	f	f	f	f	f	f	f	10	f	f	f	f	4	4
ACCENT 1-PASS [1]	22	10	f	f	10	f	f	f	—	—	f	f	f	f	f	f	f	10	f	f	f	f	f	f
ATRAZINE <1.0 kg ai/ha	10	10	10	10	10	22	22	10	—	—	—	10	10	10	22	10	10	10	22	22	10	10	4	10
ATRAZINE > 1.0–1.5 kg ai/ha	22	10	22	22	22	22	22	22	—	—	—	10	22	22	22	10	22	10	22	22	10	22	10	22
BROADSTRIKE DUAL MAGNUM BROADSTRIKE TREFLAN (Soil pH > 7.8 and OM < 2%)	10	10	f	10	10	26	26	10	10	10	10	f	f	f	f	f	f	—	f	f	10	f	4	f
CLASSIC (Soil pH 7.4 and less)	10	10	f	f	10	f	f	f	10	10	f	f	f	f	f	f	f	10	f	f	f	f	3	f
CLASSIC (Soil pH 7.4 to 7.8)	22	22	f	f	10	f	f	f	22	22	f	f	f	f	f	f	f	10	f	f	f	f	3	f
CLEAN SWEEP [1]	22	9	22	22	22	22	9	22	9	9	22	22	22	22	22	22	22	—	22	22	9	22	3.3	22
CONQUEST [1]	22	10	22	22	22	22	22	22	10	10	22	22	22	22	22	22	22	—	22	22	10	22	4	22
CONVERGE [1]	10	10	f	f	f	22	22	f	—	—	10	f	10	f	f	f	f	10	f	f	10	f	4	f
ELIM EP, PRISM	f	10	10	f	10	10	10	10	—	—	f	f	f	f	f	f	f	10	f	f	f	f	4	4
FIELDSTAR (Soil pH < 5.9 or > 7.8)	10	10	f	10	10	26	26	10	—	—	10	f	10	f	f	f	f	10	f	f	10	f	4	f
FIRSTRATE	9	f	f	9	9	26	26	f	9	9	f	f	f	f	9	f	f	—	30	30	f	f	4	f
LEXONE, SENCOR (Soil pH > 7.5)	10	10	10	10	10	22	22	10	—	—	10	10	10	10	10	10	10	—	10	22	10	10	3.3	10
LONTREL	22	10	22	22	22	—	—	22	10	22	22	10	10	22	22	10	22	22	22	22	10	22	10	22
MERIDIAN PLUS [1]	f	9	f	9	9	22	9	f	9	9	22	f	9	f	f	f	f	—	f	f	f	f	4	f
MUSTER	f	10	f	f	f	—	—	f	f	f	f	f	10	f	f	f	f	10	f	f	10	f	4	f
PATRIOT	22	10	22	10	10	22	22	22	10	—	22	22	22	22	22	22	22	22	22	22	10	22	4	22
PEAK, PEAK PLUS [1]	22	10	f	f	10	f	f	f	—	—	f	f	10	f	f	f	f	10	f	f	f	f	f	f
PURSUIT	—	10	22	—	—	22	—	22	10	—	22	22	22	22	22	22	22	—	22	22	10	22	3.3	22
REFLEX	f	f	f	—	—	18	18	f	10	10	f	f	f	f	f	f	f	—	f	f	10	f	4	f
RELIANCE STS (Soil pH 7.4 and less)	10	f	f	f	10	f	f	f	10	10	f	f	f	f	f	f	f	10	f	f	f	f	3	f
RELIANCE STS (Soil pH 7.4 to 7.8)	22	22	f	f	10	f	f	f	22	22	f	f	f	f	f	f	f	10	f	f	f	f	3	f
SIMAZINE/PRINCEP<2 kg ai/ha	—	10	10	22	22	22	22	22	—	—	10	22	10	10	10	10	10	22	22	22	10	10	10	10
SIMAZINE/PRINCEP>2 kg ai/ha	—	22	22	22	22	22	22	22	—	—	22	22	22	22	22	22	22	22	22	22	22	22	22	22
STRIKER	10	10	f	10	10	26	26	10	—	—	10	f	10	f	f	f	f	10	f	f	10	f	4	f
SUMMIT	11	11	f	11	11	22	22	f	—	—	10	f	11	f	f	f	f	11	f	f	11	11	3	f
ULTIM	f	10	10	f	10	10	10	10	—	—	f	f	f	f	f	f	f	10	f	f	f	f	4	4
ULTIMAX [1]	f	10	f	f	f	f	f	f	—	—	f	f	f	f	f	f	f	10	f	f	f	f	4	f
VALOR	18	18	18	18	18	18	18	18	10	10	18	18	18	18	18	18	18	—	18	18	18	18	18	18
VIPER [1]	f	f	f	f	f	f	f	f	10	10	f	f	f	f	f	f	f	—	f	f	f	f	4	f

— = Registered for use

[1] Herbicides sold as a co-pack under this trade name.

f = Field bioassay; user assumes liability for all crops not indicated on the label.

TABLE 2. Herbicide Crop Rotation and Soil pH Restrictions

(For other crops, consult the label.)

Horticultural Crops

	ASPARAGUS	BEANS, LIMA	BEANS, SNAP	BEETS, RED	BEETS, SUGAR	BROCCOLI	BRUSSELS SPROUTS	CABBAGE	CARROTS	CAULIFLOWER	CELERY	CORN, SWEET	CUCUMBER	GARLIC	HERBS	LETTUCE	MUSKMELON	ONIONS	PARSNIPS	PEAS	PEPPERS	POTATOES	PUMPKIN	RUTABAGA	SPINACH	SQUASH	TOMATOES (TRANSPLANTED)	WATERMELON
	Number of months between application and planting																											
ACCENT	f	f	f	f	f	f	f	f	f	f	f	f	f	f	f	f	f	f	f	f	f	f	f	f	f	f	f	f
ACCENT 1-PASS[1]	f	f	f	f	f	f	f	f	f	f	f	f	f	f	f	f	f	f	f	f	f	f	f	f	f	f	f	f
ATRAZINE <1.0 kg ai/ha	22	10	10	22	22	22	22	22	22	22	22	—	22	22	22	22	22	22	22	10	22	10	22	22	22	22	10	22
ATRAZINE > 1.0 -1.5 kg ai/ha	22	22	22	22	22	22	22	22	22	22	22	—	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22
BROADSTRIKE DUAL MAGNUM	f	10	10	f	f	f	f	f	f	f	f	22	22	f	f	f	f	f	f	10	22	22	f	f	f	f	26	f
BROADSTRIKE TREFLAN (Soil pH > 7.8 and OM < 2%)	f	f	f	f	f	f	f	f	f	f	f	f	f	f	f	f	f	f	f	f	f	f	f	f	f	f	f	f
CLASSIC (Soil pH 7.4 and less)	f	f	f	f	f	f	f	f	f	f	f	f	f	f	f	f	f	f	f	f	f	f	f	f	f	f	f	f
CLASSIC (Soil pH 7.4 to 7.8)	22	22	22	f	f	22	22	22	22	22	22	22	22	22	22	22	22	22	22	—	22	22	22	22	22	22	22	22
CLEAN SWEEP[1]	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22
CONQUEST[1]	f	f	f	f	f	f	f	f	f	f	f	f	f	f	f	f	f	f	f	f	10	f	f	f	f	f	f	f
CONVERGE[1]	f	f	f	f	f	f	f	f	f	f	f	f	f	f	f	f	f	f	f	f	—	f	f	f	f	—	f	f
ELIM EP, PRISM	f	10	10	f	f	f	f	f	f	f	22	22	f	f	f	f	f	f	f	10	f	26	f	f	f	f	26	f
FIELDSTAR (Soil pH < 5.9 or > 7.8)	f	f	9	9	f	f	f	f	f	f	18	f	f	f	f	f	f	f	f	9	f	f	f	f	f	f	f	f
FIRSTRATE	—	10	10	22	22	22	22	22	10	22	22	10	22	10	10	22	22	22	10	10	22	—	22	22	22	22	—	22
LEXONE, SENCOR (Soil pH > 7.5)	22	22	22	22	—	—	22	—	22	—	22	22	22	22	22	22	22	22	22	22	22	22	22	—	22	22	22	22
LONTREL	f	f	f	f	f	f	f	f	f	f	f	f	f	f	f	f	f	f	f	f	f	f	f	f	f	f	9	f
MERIDIAN PLUS[1]	f	f	f	f	f	f	f	f	f	f	f	f	f	f	f	f	f	f	f	f	f	f	f	f	f	f	f	f
MUSTER	f	f	f	f	f	f	f	f	f	f	f	f	f	f	f	f	f	f	f	f	f	f	f	f	f	f	f	f
PATRIOT	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	10	22	22	22	22	22	22	22	22
PEAK, PEAK PLUS[1]	f	f	f	f	f	f	f	f	f	f	f	f	f	f	f	f	f	f	f	10	f	f	f	f	f	f	f	f
PURSUIT	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	—	22	22	22	22	22	22	22	22
REFLEX	f	f	—	18	18	18	18	18	f	18	f	18	f	f	f	f	f	f	f	f	f	f	f	18	f	f	f	f
RELIANCE STS (Soil pH 7.4 and less)	f	f	f	f	f	f	f	f	f	f	f	f	f	f	f	f	f	f	f	f	f	f	f	f	f	f	f	f
RELIANCE STS (Soil pH 7.4 to 7.8)	f	f	f	f	f	f	f	f	f	f	f	f	f	f	f	f	f	f	f	f	f	f	f	f	f	f	f	f
SIMAZINE/PRINCEP<2 kg ai/ha	22	22	22	10	22	22	22	22	22	22	22	10	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22
SIMAZINE/PRINCEP>2 kg ai/ha	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22
STRIKER	f	10	10	f	f	f	f	f	f	f	f	22	22	f	f	f	f	f	f	10	f	26	f	f	f	f	26	f
SUMMIT	f	f	f	f	f	f	f	f	f	f	f	f	f	f	f	f	f	f	f	10	f	f	f	f	f	f	f	f
ULTIM	f	f	f	f	f	f	f	f	f	f	f	f	f	f	f	f	f	f	f	f	f	f	f	f	f	f	f	f
ULTIMAX[1]	f	f	f	f	f	f	f	f	f	f	f	f	f	f	f	f	f	f	f	f	f	f	f	f	f	f	f	f
VALOR	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18
VIPER[1]	f	f	f	f	f	f	f	f	f	f	f	f	f	f	f	f	f	f	f	f	f	f	f	f	f	f	10	f

— = Registered for use

f = Field bioassay; user assumes liability for all crops not indicated on the label.

[1] Herbicides sold as a co-pack under this trade name.

TABLE 3 - Herbicide Groupings for Ontario

1	Inhibitors of acetyl CoA carboxylase (ACCase)	Acclaim Super, Achieve, Assure, Assure II, Excel Super, Hoe-grass, Poast Ultra, Select, Venture	
2	Inhibitors of acetolactate synthase (ALS) and also called acetohydroxyacid synthase (AHAS)	Accent, Arsenal, Classic, Elim EP, FirstRate, Muster, Pinnacle, Peak, Prism, Pursuit, Refine Extra, Reliance STS, Telar, Ultim, Upbeet	Accent 1-Pass[3](2,4), Broadstrike Dual Magnum(2,15), Broadstrike Treflan(2,3), Cleansweep[3](2,6), Conquest[3](2,5), Fieldstar(2,4), Meridian Plus[3](2,6), Patriot(2,5), PeakPlus[3](2,4), Striker(2,4), Summit(2,4), Ultimax[3](2,4), Valor(2,3), Viper[3](2,14)
3	Microtubule assembly inhibitors	Bonanza, Dimension, Prowl, Rival, Treflan	Broadstrike Treflan(2,3), Valor(2,3)
4	Synthetic auxins	Banvel II, Caliber, Cobutox, Compitox, Covitox Plus, Dichlorprop-D, Diphenoprop, Dycleer, Dyvel, Embutox, Estaprop, Estasol, Estamine 2,4-D, Ester, Expedite Broadleaf, Garlon, Kil-Mor, Killex, Lontrel, MCPA, Mecoprop, Mecocrop 2,4-D, Mecoturf Plus 2,4-D, Meco-D, Par III, Premium 3-Way, Release, Savage, Sword, Target, Tordon 101 mix, Tricep, Turf Herbicide, Turf-Rite 2+2, Turboprop, Vanquish, Weedone CB	Accent 1-Pass[3](2,4), Buctril M(4,6), Distinct(4,19), Fieldstar(2,4), Marksman(4,5), PeakPlus[3](2,4), Shotgun(4,5), Stampede CM(4,7), Striker(2,4), Summit (2,4), Ultimax[3](2,4),
5	Inhibitors of photosynthesis at photosystem II, Site A	Aatrex, Atrazine, Betamix, Betanex, Bladex, Evict, Gesagard, Hyvar X, Lexone, Princep, Pronone, Pyramin FL, Sencor, Simadex, Simazine, Sinbar, Spin-Aid, Velpar	Axiom(5,15), Boundary[3](5,15), Conquest[3](2,5), Converge(5,28), Krovar(5,7), Laddok(5,6), LibertyPrime[3](5,10,15), Marksman(4,5), Patriot(2,5), Primextra II Magnum(5,15), Shotgun(4,5),
6	Inhibitors of photosynthesis at photosystem II, Site A	Basagran, Basagran Forte, Koril, Lentagran, Pardner	Buctril M(4,6), Cleansweep[3](2,6), Laddok(5,6), Meridian Plus[3](2,6), Mextrol(4,6)
7	Inhibitors of photosynthesis at photosystem II, Site B	Afesin, Afolan, Herbec, Karmex, Linuron, Lorox, Patoran,	Krovar(5,7), Stampede CM(4,7)
8	Conjugation of acetyl co-enyme A	Avadex, Avenge, Betasan, Eradicane, Eptam, Ro-Neet	
9	Inhibitors of 5-enolpyruvylshikimimate-3-phosphate synthase (EPSP)	Clear-It, Credit, Expedite Grass & Weed, EZJect, Glyfos, Laredo, Renegade, Roundup, Touchdown, Vantage, Vision, Wrangler	Roundup Fast Forward(9,10)
10	Inhibitors of glutamine synthetase	Ignite, Liberty	LibertyPrime[3](5,10,15), Roundup Fast Forward(9,10)
11	Inhibitors of carotenoid biosynthesis	Amitrol	
14	Inhibitors of protoporphyrinogen oxidase (Protox)	Blazer, Goal, Reflex, Ronstar	Viper[3](2,14)
15	Conjugation of acetyl co-enyme A	Devrinol, Dual Magnum, Dual II Magnum, Frontier	Axiom(5,15), Boundary[3](5,15), Broadstrike Dual Magnum(2,15), LibertyPrime[3](5,10,15), Primextra II Magnum(5,15),
19	Inhibitors of auxin transport system	Alanap	Distinct(4,19)
20	Inhibits cell wall synthesis, Site A	Casoron	
22	Photo system I - electron diverters	Gramoxone, Reglone, Reward, Weed & Grass Killer	
23	Inhibitors of mitosis	CIPC	
27	others	Basamid, Krenite, Vapam	
28	Inhibitors of p-hydroxyphenyl pyruvate dioxygenase (HPPD)		Converge(5,28)

[1] Herbicide groupings for Ontario follow the Weed Science Society of America's nationally accepted grouping. Groups 12, 13, 16, 17, 18, 21, 24, 25 and 26 are not available in Ontario.

[2] Products with two or more sites of action are followed by the group numbers involved.

[3] Indicates herbicides sold as a co-pack under this trade name.

TABLE 4. Interval Before Rainfall (Postemergence)

Rainfall shortly after application of a postemergence herbicide may reduce the weed control. This effect will vary with the product, the formulation, the interval of time and the drying conditions between application and rainfall, as well as on the amount, intensity, and duration of rainfall. The following information is based on label information and additional detail supplied by the chemical industry. **For further information, contact the manufacturer.** In the case of a tank-mix, use the longest time interval of the products being considered.

DIMENSION	ACHIEVE	2,4-D Ester	ACCLAIM SUPER	2,4-D amine	AMITROL 240	AFOLAN F	MECOTURF plus 2,4-D
GRAMOXONE	ASSURE II	ACCENT	GOAL 2XL	ACCENT 1-PASS[1]	AVENGE 200C	LINURON 480	
REGLONE DESICCANT	BUCTRIL M	ARSENAL	SWORD	BANVEL II	BASAGRAN	LOROX	
REWARD	CALIBER 400	atrazine	TARGET	CLOVITOX PLUS	BASAGRAN FORTE		
	COBUTOX 600	BLADEX		DISTINCT	BETAMIX		
	EMBUTOX 625	CLASSIC		DYCLEER	BETANEX		
	EXCEL SUPER	ESTAPROP		DYVEL	BLAZER		
	HOE-GRASS	ELIM		IGNITE	CLEANSWEEP[1]		
	KORIL	FIRSTRATE		LIBERTY 200 SN	CREDIT		
	MEXTROL	FUSILADE II		LIBERTYPRIME[1]	GLYFOS		
	PARDNER	GARLON 4		LONTREL	KIL-MOR		
	PATRIOT	LENTAGRAN		MARKSMAN	LADDOK		
	POAST ULTRA	MCPA ester		MCPA amine	LEXONE		
	SELECT	PRISM		MERIDIAN PLUS[1]	MCPA sodium		
	WEEDONE CB	PURSUIT		MUSTER	PYRAMIN FL		
		SHOTGUN		PEAKPLUS[1]	ROUNDUP		
		TORDON 101		PINNACLE	SENCOR		
		ULTIM		REFINE EXTRA	SPIN-AID		
		VENTURE		REFLEX	STRIKER		
				RELIANCE STS	TOUCHDOWN		
				ROUNDUP TRANSORB	ULTIMAX[1]		
				SAVAGE	VANTAGE		
				STAMPEDE CM			
				SUMMIT			
				TROPOTOX PLUS			
				UPBEET			
				VANQUISH			
				VANTAGE PLUS			
				VIPER[1]			

[1] indicates herbicides sold as a co-pack under this Trade name

CHAPTER 5. NOTES ON ADJUVANTS

Introduction

An adjuvant is any substance added to a spray solution to modify and enhance the effectiveness of the herbicide.

Adjuvants are an important part of the spray solution and, if omitted, weed control can be reduced. Some products have adjuvants formulated into the product while other adjuvants are added by the user. The selection of adjuvants is key to getting the right balance between maximizing weed control and minimizing crop injury. In some cases the rate of adjuvant will vary depending on conditions of weather, crop stage, weed species, water quality, etc. Some herbicide labels recommend particular adjuvant products and some recommend particular types of adjuvants. Always use adjuvants as directed on the product label.

Most adjuvant recommendations in this guide are listed as the amount (in litres) that would would added to 1000 L (L/1000 L) of spray solution. If you wish to convert to % volume/volume (v/v) use the following conversion:

10 L/1000 L = 1 % v/v

There are 2 broad categories of adjuvants:

- Activators and spray modifiers
- Utility modifiers

Activators and spray modifiers

- **Surfactants** (also known as "surface active agents") **are the** largest class of adjuvants. Surfactants can be non-ionic, anionic, cationic or amphuteric. Most surfactants are non-ionic (NIS); they do not ionize. A NIS is used to enhance herbicide penetration into a waxy cuticle. Wetting agents and detergents are primarily anionic and when ionized in solution, the water soluble portion is negatively charged. Cationic surfactants exhibit a net positive charge in solution. Amphuteric surfactants can be either anionic or cationic. Cationic and amphuteric are not widely used in agricultural chemicals.
- **Oils** solubilize the waxy cuticle layer on a weed to increase spray penetration through the leaf cuticle. Oils can be refined mineral oils (petroleum based) or seed oils. Seed oils can be categorized as triglycerides, methylated seed oils (MSO) or crop oil concentrates (COC). Crop oil concentrates are a combination of seed oil and surfactants.
- **Spreaders** are wetting agents that reduce the surface tension to create better contact between the spray solution and the treated surface (leaf, etc). A **sticker** increases the herbicide adhesion to the leaf surface.

Utility modifiers

- **Compatibility** agents improve mixing, especially when using a liquid fertilizer carrier
- **Drift control** agents increase the droplet size to reduce drift.
- **Anti-foaming** agents are used to reduce foaming in the spray tank.
- **Foaming** agents are used with specialized equipment to produce and apply a foam.
- **Buffering** agents can be used enhance solubility or adjust pH.

Note

The following notes should be considered with the recommendations given later in this publication. Additional information on use, toxicity and safety precautions is given here. With a few exceptions the adjuvants are listed under their trade or product name. See *Table 5* for a summary of adjuvants listed in this publication.

Complete information on each adjuvant is available on the product label which is located on the product container. The federal Pest Management Regulatory Agency also lists pesticide labels on their internet website at: http://64.26.129.82/search/queryhit.htm.

Many pesticide manufacturers also list product labels and/or Material Safety Data Sheets (MSDS) on their websites which are listed on the last page of this publication.

38-F DRIFT RETARDANT

Type of Adjuvant: Drift-control agent. **Chemical Composition:** Polyacrylamide polymer 32%. **Registered Uses:** For non-crop use with most water-soluble, emulsifiable or wettable-powder formulations of pesticides. **Benefit:** Drift control. **Mode of Action:** When tank mixed with a pesticide, 38-F reduces drift by materially reducing fines resulting from shear. **Mixing:** Add 38-F at a steady rate into the mixing tank at the point of maximum agitation. In most cases, this is where the liquid level in the tank is at or just below the injection point of the filling water. After the last tank addition has been made, allow the mixing to continue for a few minutes before using. Refer to product label for more information.

AGRAL 90

Type of Adjuvant: Non-ionic surfactant. **Chemical Composition:** Nonylphenoxy polyethyoxyethanol 90%. **Registered Uses:** For use with diquat, paraquat, glyphosate, imazethapyr, rimsulfuron, nicosulfuron/rimsulfuron and for washing sprayer tanks and equipment. **Benefit:** Improves chemical effectiveness. **Mode of Action:** It is a wetting and spreading agent that improves coverage of spray mixes. **Mixing:** Use 250–1000 mL/1000 L of spray as specified on label. Will mix with all types of water. Add AGRAL 90 to the spray mixture and agitate thoroughly. **Unique Characteristics:** Do not exceed the recommended rates of AGRAL 90 as too much wetting agent can lead to loss of spray due to excessive run-off.

AG-SURF

Type of Adjuvant: Non-ionic surfactant. **Chemical Composition:** Nonylphenoxy polyethyoxyethanol 92%. **Registered Uses:** For use with glyphosate, imazethapyr and fluazifop-p-butyl. **Benefit:** Improves chemical effectiveness. **Mode of Action:** It is a wetting and spreading agent that improves coverage of spray mixtures. **Mixing:** For use with ROUNDUP: when applying the 2.5 L/ha of water, add AG-SURF at 0.5% (0.50 L/100L water) to maintain adequate surfactant concentration. For use with ROUNDUP to control annual grasses and broadleaf weeds for minimum or zero-till: use 350 mL/ha plus ROUNDUP at 1.1 L/ha in 50–100 L/ha of clean water. For use with FUSILADE 250EC: add 100 mL of AG-SURF for each 100 L of spray solution (0.1%). An antifoaming agent may be required to reduce foaming. **Unique Characteristics:** Do not exceed recommended rates of AG-SURF, as too much may reduce the effectiveness of the herbicide due to excessive run-off. Consult product label for full directions.

AMIGO

Type of Adjuvant: Surfactant. **Chemical Composition:** 30% phosphate ester surfactant. **Registered Uses:** For use with clethodim and clethodim tank mixes. **Benefit:** Improves chemical effectiveness under varying environmental conditions. **Mode of Action:** Improves spreading of spray droplets on the leaf surface and increases contact area. Enhances penetration of herbicide through the leaf cuticle layer. **Mixing:** Half-fill spray tank with water and start agitation. Add the correct amount of herbicide, agitate and then add the correct amount of AMIGO with the remaining water. Continue to agitate.

AMMONIUM SULPHATE

Type of Adjuvant: Liquid fertilizer or any granular. **Chemical Composition:** 490 grams/litre ammonium sulphate in water or 100% dry. **Registered Uses:** BASF LIQUID AMMONIUM SULPHATE is registered for use with POAST ULTRA on various crops and BASAGRAN in soybeans only. **Benefit:** Improved and more consistant control of weeds under varying environmental conditions with POAST ULTRA (wild oats, volunteer cereals and quack grass) or BASAGRAN (velvetleaf and lamb's-quarters). **Mode of Action:** Improved uptake of herbicide related to spray or droplet characteristics. **Mixing:** Half-fill spray tank with water and agitate continuously, add LIQUID AMMONIUM SULPHATE followed by POAST ULTRA or BASAGRAN, continue to fill spray tank and add ASSIST oil concentrate last. **Unique Characteristics:** Liquid ammonium sulphate is extremely corrosive to metals, therefore, all metal sprayer parts coming into contact with the spray solution should be checked regularly. Metal spray tips will be subject to corrosion, so the sprayer should be calibrated regularly during the season and tips replaced when necessary.

AQUASHADE

Chemical Family: Water-soluble dyes. **Crop and/or Non-Crop Registrations:** Contained golf course, farm and industrial ponds, fountains and aquariums. **Sensitive Weeds:** Filamentous algae and certain aquatic weeds. **Uptake and Translocation:** The dye filters wavelengths of sunlight reducing the light intensity. **Application Methods:** May be added in a concentrated form from the shoreline or diluted form for larger areas. It is recommended to make the application early in the growing season before algae and weed growth develops. Mechanical removal of heavy vegetation is recommended before applying Aquashade if fish are present in the pond. **Residual Activity:** The effect lasts as long as the water keeps its blue color. Additional Aquashade can be applied when the color of the water fades or when the first new algae and weed growth is noticed. **Unique Characteristics:** It has no direct chemical action and will therefore not harm fish.

ASSIST OIL CONCENTRATE

Type of Adjuvant: Mineral oil/surfactant (non-herbicidal). **Chemical Composition:** 83% paraffin base mineral oil plus 17% surfactant blend. **Registered Uses:** ASSIST OIL CONCENTRATE is registered for use with sethoxydim, BASAGRAN, bentazon/atrazine and atrazine. **Benefit:** The use of ASSIST results in improved postemergence activity and a greater degree of consistency under varying environmental conditions. ASSIST will also aid in providing a faster weed kill. **Mode of Action:** Reduces the evaporation of spray droplets on the leaf surface leading to a longer period for penetration. Improves penetration through the leaf cuticle layer. ASSIST also aids in spreading a spray droplet on the leaf surface so that it covers a greater surface area.

Mixing: Half-fill the spray tank with water and begin agitation. Add the desired amount of herbicide and continue filling. Add ASSIST last. After filling, continue agitation. Agitate thoroughly after any stoppage in spraying. **Unique Characteristics:** May cause increased temporary topical burn to crop plants under hot, humid weather conditions.

BREAKER

Type of Adjuvant: Antifoamer/Defoamer. **Registered Uses:** To reduce foaming when preparing herbicide spray mixes. **Benefit:** Small quantities of BREAKER added before adding herbicides will prevent foam from forming. **Mixing:** Add 7 mL/500 L of spray mix. **Unique Characteristics:** Can be added after foam has formed but more time will be required to eliminate the foam.

CANPLUS 411

Type of Adjuvant: Mineral oil/surfactant (non-herbicidal). **Chemical Composition:** 83% paraffin-base mineral oil plus 17% surfactant blend. **Registered Uses:** CANPLUS 411 is registered for use with ASSURE II. **Benefit:** The use of CANPLUS 411 results in improved postemergence activity and a greater degree of consistency under varying environmental conditions. **Mode of Action:** Reduces the evaporation of spray droplets from the leaf surface and decreases the surface tension of spray droplets, thus improving the penetration through the cuticle of leaf surfaces. **Mixing:** Add the required amount of water to spray tank with agitator running. Add ASSURE II and when well mixed add 5–10 L of CANPLUS 411 for each 1000 L of spray solution. **Unique Characteristics:** May cause increased temporary phytotoxicity to crop plants under hot humid weather conditions.

CHOICE

Type of Adjuvant: Water conditioning agent. **Chemical Composition:** Blend of polyacrylic, hydroxy carboxylic, propionic acids, phosphate ester and ammonium sulfate. **Benefit:** Eliminates "hard water antagonism" and instrability due to high pH. **Mode of Action:** Conditions water by sequestering or chelating hard water ions and by the reduction in pH. **Mixing:** 2.5–7.5 L/1000 mL water.

CITOWETT PLUS

Type of Adjuvant: Non-ionic spreader sticker surfactant. **Chemical Composition:** Octyl phenoxy poly polyethoxy ethanol 50%. **Registered Uses:** Corn/atrazine; sugar beets and red beets/pyrazon; peas/bentazon. **Benefit:** Improves postemergence control of weeds that have reached their upper limit in size for susceptibility. **Mode of Action:** Causes the spray mix to form a continuous film on leaf surfaces; also makes herbicide more rainfast. **Mixing:** Half-fill tank with water; add herbicide with continuous agitation; complete filling of tank with water; add CITOWETT with continuous agitation. **Unique Characteristics:** Higher rates are required with hard water.

COMPANION

Type of Adjuvant: Non-ionic surfactant. **Chemical Composition:** Octylphenoxy-polyethoxy-(9)-ethanol 70%. **Registered Uses:** For use with chlorsulfuron. **Benefit:** Improves chemical effectiveness. **Mode of Action:** It is a wetting and spreading agent that improves coverage of spray mixes. **Mixing:** For use with glyphosate for the control of annual grasses and broadleaf weeds, add 450 mL of COMPANION in 50–100 L of water/ha. With chlorsulfuron, add 100 mL of COMPANION to 100 L of water for the control of broadleaf weeds. Use constant agitation. **Unique Characteristics:** Do not exceed the recommended rates of COMPANION as too much may reduce the effectiveness of the herbicide due to excessive run-off.

COMPATABILITY AGENTS

(see UNITE)

CORNOIL

(See KORNOIL)

CORNOIL CONCENTRATE

(See KORNOIL CONCENTRATE)

ANTIFOAMERS/DEFOAMERS

(See BREAKER, FIGHTER F, FLAT-OUT, HALT, SPRAY ADJUVANT DEFOAMER)

DRIFT-CONTROL AGENTS

(See 38-F DRIFT RETARDANT, NALCO-TROL, ON TARGET.)

ENHANCE

Type of Adjuvant: Cationic surfactant with an additional non-ionic component. **Chemical Composition:** Mixture of tallow fatty acid amine ethoxylate and nonylphenoxy polyethoxy ethanol. **Registered Uses:** Season-long control of quack grass at low rate of glyphosate. For use with post-emergent applications of imazethapyr in soybeans. **Benefit:** Improves consistency of performance, particularly at high water volumes and under stressful growing conditions. **Mode of Action:** Improves leaf wetting and adhesion; increases overall penetration, resulting in enhanced uptake of glyphosate. **Mixing:** Half-fill the sprayer tank with clean water then add the required amount of glyphosate. While agitating, add the required amount of ENHANCE (0.5 L/ha in 100–200 L/ha of water) and complete filling the sprayer tank with water.

FIGHTER F

Type of Adjuvant: Antifoamer-Defoamer. **Chemical Composition:** Dimethyl-polysiloxane 10%. **Registered Uses:** To control foam in water, oil, fertilizer and pesticide spray mixtures. **Benefit:** Controls foam when mixing sprays, eliminates material waste, provides more accurate metering of agricultural sprays, and eliminates foam overflow at fill site. **Mixing:** To control foam when mixing spray solution, add defoamer either just before or during addition of any other spray adjuvant. To cut existing foam, add defoamer to tank and recirculate solution until foam dissipates.

FLAT-OUT

Type of Adjuvant: Defoamer. **Chemical Composition**: Dimethylpolysiloxane 18% Silicone base neutral. **Registered Uses:** To control foam formation or existing foam, use as premix or add while spray tank is being filled. **Benefit**: The reduction of foam allows for faster tank fill, ensures fill volumes are correct and reduces the possibility of chemical overflow, therefore more accurate application. It also makes the cleaning process easier. Mixing: Add 5–10 mL/100 L of solution. Adjust the amount required according to individual conditions. May be used before mixing to prevent foam, or after to cut foam. May be used with any herbicide unless contraindicated on the label.

FOAM MARKERS

(See TREKKER TRAX)

HALT

Type of Adjuvant: Defoamer. **Chemical Composition:** Silicone base, neutral. **Registered Uses:** To reduce foaming when preparing herbicide spray mixes. **Benefit:** The reduction of foaming allows faster tank fill-ups, ensures correct fill volumes, reduces the possibility of chemical overflow and gives more accurate herbicide application. **Mixing:** Add 7 mL/500 L of spray mix. May be added to spray tank during filling to prevent foaming, or after to cut foam. **Unique Characteristics:** May be used with any herbicide unless contraindicated on the label.

HERBICIDAL OIL

(See **Notes on Herbicides** MINERAL OIL [HERBICIDAL].)

KORNOIL

Type of Adjuvant: Mineral oil (non-herbicidal). **Chemical Composition:** 98.5% mineral oil, 1.5% emulsifier. **Registered Uses:** (Crop/herbicide): Corn/atrazine. **Benefit:** Improved postemergence activity of atrazine. **Mode of Action:** Partially dissolves waxy cuticle of weeds allowing atrazine to penetrate more readily. **Mixing:** Fill spray tank with water allowing space for subsequent addition of atrazine and oil; engage agitation and pour in premixed slurry of atrazine in water; add KORNOIL last. Avoid excessive agitation of the spray mix as this may cause coagulation or buttering out. **Unique Characteristics:** To prevent a build-up of oil in the sprayer, empty the tank as completely as possible before refilling. Some injury may occur if the crop is stressed (cold weather or hot, dry weather).

KORNOIL CONCENTRATE

Type of Adjuvant: Mineral oil/surfactant (non-herbicidal). **Chemical Composition:** Paraffin-base mineral oil 85%, surfactant blend 15%. **Registered Uses:** To be blended with atrazine/water mixtures and applied postemergence in corn. **Benefit:** Improved postemergence activity of atrazine. **Mode of Action:** Partially dissolves waxy cuticle of weeds allowing atrazine to penetrate more readily. Also reduces evaporation and aids in spreading of spray droplets on the leaf surface leading to a longer period for penetration. **Mixing:** Avoid violent agitation; partially fill sprayer, add atrazine slurry, add KORNOIL CONCENTRATE last. **Unique Char-acteristics:** Some injury may occur with cold; rainy weather.

LI700

Type of Adjuvant: Non-ionic surfactant and pH Adjuster/Acidifier. **Chemical Composition:** Phosphatidylcholine, meth-ylacetic acid and alkyl polyoxyethylene ether 80%. **Registered Uses:** As a penetrating surfactant; as a pH adjuster/acidifier; for use with glyphosate products such as ROUNDUP, LAREDO, RENEGADE, WRANGLER and VISION. Alkaline water, even mildly alkaline, causes alkaline hydrolysis or degradation of many pesticides. Some chemicals degrade in less time than it takes to put out a tank of spray. When mixed with spray solutions, LI700 neutralizes or slightly acidifies the spray solution and prevents the breakdown hydrolysis of pH-sensitive products in the spray tank. Add LI700 before adding the pesticide. **Benefit:** Improves chemical effectiveness. **Mixing:** As a penetrating surfactant: Use 5 L of LI700/1000 L spray mixture or 500 mL of LI700/100 L spray mixture. As a pH adjuster/acidifier: Highly alkaline water, (pH 8 or higher), Use: 625 mL–1.25L LI700/1000 L water mixture.

MERGE

Type of Adjuvant: Surfactant/solvent. **Chemical Composition:** 50% surfactant blend plus 50% solvent (petroleum hydrocarbons). **Registered Uses:** For use with sethoxydim. **Benefit:** Improves chemical effectiveness and provides a greater degree of consistency under varying environmental conditions. **Mode of Action:** Improves spreading of spray droplets on the leaf surface and increases contact surface area. Improves penetration of herbicide through the leaf cuticle layer. Acts as a protectant against photodegradation of sethoxydim by UV light. **Mixing:** Half-fill spray tank with water, start agitation. Add required amount of herbicide and continue agitation. Add MERGE, along with remaining water, last to the tank. Agitate thoroughly after any stoppage in spraying. **Unique Characteristics:** May cause temporary topical burn to crop plants under hot, humid weather conditions.

MINERAL OIL

(NON-HERBICIDAL) (see KORNOIL)

MINERAL OIL/SURFACTANT (NON-HERBICIDAL)

(See ASSIST OIL CONCENTRATE, CHARGE OIL CONCENTRATE, KORNOIL CONCENTRATE XA OIL CONCENTRATE)

NALCO-TROL

Type of Adjuvant: Drift-control agent. **Chemical Composition:** Polyvinyl polymer. **Registered Uses:** For use with 2,4-D ester or amine, picloram, paraquat, simazine or dicamba for weed or brush control in non-

crop land. **Benefit:** Reduces drift, improves canopy penetration and foliage coverage. **Mode of Action:** Reduces spray break-up and thus the number of fine, driftable droplets. **Mixing:** Use 3–1000 mL/1000 L, depending on pressure, height and nozzle type. Add water and, while agitating, add NALCO-TROL before adding liquid herbicides. Add wettable-powder herbicides to water and ensure dispersion before adding NALCO-TROL. **Unique Char-acteristics:** Product is extremely slippery; care should be taken when working on spray equipment and following a spill.

OIL

(See MINERAL OIL).

ON TARGET

Type of Adjuvant: Deposition Aid / Drift Control agent. **Chemical Composition**: Polyvinyl Polymer (Polyacrylamide) 30%. **Registered uses**: for use with most water soluble and wettable powder pesticides and desiccants, including Glyphosate, when applied by aerial application or standard ground equipment. **Benefit**: Deposition improvement and drift retardation in spraying operations, to potentially reduce injury to adjacent crops or plants. **Mode of Action**: When tank mixed with a pesticide ON TARGET reduces drift by materially reducing fines resulting from shear. **Mixing**: Fill mix tank with water, pesticide and other additives and begin to agitate. Select correct dosage, SHAKE BOTTLE WELL BEFORE USING, either inject ON TARGET liquid into the suction side of the feeder or recirculating pump or slowly add ON TARGET liquid to the rapidly agitating tank mix in the area of highest turbulence by pouring a very thin stream. This obtains the best dispersion of the polymer throughout the pesticide solution. Allow mixing to continue for at least 2 minutes before spraying.

SIDEKICK

Type of Adjuvant: Non-ionic liquid spreader/activator. **Chemical Composition:** Alkylarylpolyoxyethylene glycols, free fatty acids & isopropyl alcohol **Registered Uses:** For use with imazethapyr, metsulfuron-methyl, nicosulfuron, quizalofop-ethyl. **Benefit:** Improves spray chemical effectiveness. **Mode of Action:** It is a wetting and spreading agent that improves coverage of spray mixtures. **Mixing:** Make sure the spray tank is thoroughly cleaned before mixing. Fill the spray tank half full with water. Add the required amount of herbicide as directed by its label with the agitator running. Ensure that the herbicide is completely mixed before proceeding to the next step. SLOWLY add the SIDEKICK, agitating during the entire process. Continue to agitate while filling the tank with water and agitate before and during each application to insure a uniform spray. **Unique Characteristics:** Do not exceed recommended rates of SIDEKICK, as too much may reduce the effectiveness of the herbicide due to excessive run-off. Consult product label for full directions.

SPRAY ADJUVANT DEFOAMER

Type of Adjuvant: Defoamer. **Chemical Composition:** Dimethylpolysiloxane. **Registered Uses:** To reduce foaming in spray mixes of atrazine. **Benefit:** Reduces foaming. **Mixing:** To control foam when mixing spray solution, add defoamer either just before or during addition of any other spray adjuvant. To cut existing foam, add defoamer to tank and recirculate solution until foam dissipates. **Unique Characteristics:** Do not use with any other herbicide or herbicide/adjuvant mixture.

SUPER SPREADER

Type of Adjuvant: Non-ionic spreader sticker surfactant. **Chemical Composition:** Octyl phenoxypoly ethoxy ethanol 50%. **Registered Uses:** For use with ALLY, AMBER, atrazine, BASAGRAN, ELIM, MUSTER, PINNACLE, TELAR, PYRAMIN FL, REFINE, REFINE EXTRA, ULTIM. **Benefit:** Improves postemergence control of weeds that have reached their upper limit in size for susceptibility. **Mode of Action:** Causes the spray mix to form a continuous film on leaf surfaces; also makes herbicide more rainfast. **Mixing:** Use 1–2.5 L/ha. Half-fill tank with water; add herbicide with continuous agitation; complete filling of tank with water; add SUPER SPREADER STICKER with continuous agitation. **Unique Characteristics:** Higher rates are required with hard water.

SURE-MIX

Type of Adjuvant: Paraffinic petroleum oil/surfactant (non-herbicidal). **Chemical Composition:** 60% Paraffinic petroleum oil plus 35.6% surfactant blend. **Registered uses:** SURE-MIX is registered for use with ASSURE II. **Benefit:** The use of SURE-MIX results in improved activity of ASSURE II and a greater degree of consistency under varying environmental conditions. **Mode of Action:** Reduces the evaporation of spray droplets from the leaf surface and decreases the surface tension of spray droplets thus improving penetration through the cuticle of leaf surfaces. **Mixing:** Add the required amount of water to the spray tank with agitator running. Add ASSURE II and after well mixed add 5 L of SURE-MIX for each 1000 L of spray solution. **Unique characteristics:** May cause some minor leaf speckling under hot and humid weather conditions.

SURFACTANTS

(See AGRAL 90, AG-SURF, COMPANION, CANPLUS 411,CITOWETT PLUS, ENHANCE, LI700, MERGE, SIDEKICK, SUPER SPREADER, SYLGARD 309, XA OIL CONCENTRATE).

SYLGARD 309

Type of Adjuvant: Non-ionic surfactant. **Chemical Composition:** Siloxylated polyether 76%. **Registered Uses:** For use with bentazon on soybeans for annual broadleaf weed control; imazethapyr on soybeans for annual broadleaf and grass control; and glyphosate for quack grass control and annual broadleaf weed control in summer fallow; and with picloram/2,4-D for faster burndown of coniferous species on right-of-ways. **Benefits**: Improves chemical effectiveness by increasing the amount and rate of uptake of water-soluble herbicides. **Mixing:** Use 2.5 L/1000 L of spray solution for most applications; add this amount last to the spray tank after the herbicide has been thoroughly mixed.

Apply the spray solution as soon as possible after mixing. **Unique Characteristics:** This organosilicone formulation has lowest surface tension of any adjuvant available.

TREKKER TRAX

Type of Adjuvant: Foam marker. **Chemical Composition:** 24% alcohols and 30% mixed anionic and nonionic surfactants. **Benefit:** Improves placement of herbicides by indicating area of field sprayed. **Mixing:** Depending on water hardness, use 1–2 L/100–150 L water.

TURBOCHARGE

Type of Adjuvant: Surfactant/solvent. **Chemical Composition:** 39.5% surfactant blend plus 50% solvent (mineral oil). **Registered Uses:** For use with ACHIEVE 40 DG herbicide. **Benefit:** Improves chemical effectiveness and provides a greater degree of consistency under varying environmental conditions. **Mode of Action:** Improves spreading of spray droplets on the leaf surface and increases contact surface area. Improves penetration of herbicide through the leaf cuticle layer. **Mixing:** Half-fill spray tank with water, start agitation. Add required amount of herbicide and continue agitation. Add TURBOCHARGE along with remaining water last to the tank. Agitate thoroughly after any stoppage in spraying. Use at a rate of 0.5 L TURBOCHARGE/100 L of spray mixture. If tank mixing with other herbicides, always add the TURBOCHARGE last.

UNITE

Type of Adjuvant: Compatibility Agent. **Chemical Composition:** 83.7% acid polyglycols and methyl alcohol. **Benefit:** Improves the compatibility of liquid fertilizer-pesticide mixtures. **Mixing:** 240–1420 mL/378.5 L. A test of physical compatibility of various pesticides and fertilizer mixtures should be performed in a small quantity to determine the exact amount of UNITE and the mixing method to be used.

WATER CONDITIONING AGENTS

(See CHOICE)

WATER-SOLUBLE DYES

See AQUASHADE.

XA OIL CONCENTRATE

Type of Adjuvant: Mineral oil/surfactant (non-herbicidal). **Chemical Composition:** 83% paraffin-base mineral oil plus 17% surfactant blend. **Registered Uses:** atrazine, ASSURE, BASAGRAN, LADDOCK. **Benefit:** May result in improved postemergence activity. **Mode of Action:** Reduces the evaporation of spray droplets from the leaf surface and decreases the surface tension of spray droplets, thus improving the penetration through the cuticle of leaf surfaces. **Unique Characteristics:** Caution with new corn varieties. Do not mix with 2,4-D; MCPA; 2,4-DB; cyanazine; MCPB or dicamba.

TABLE 5. Adjuvants Used in Ontario

Brand and Trade Names* (see endnote)	Type of Adjuvant	Chemical Composition	Guaranteed Active	Ontario Schedule	Winter Storage	Manufacturer/ Agent Code
38-F	drift retardant	polyacrylamide	82%	3	C	UAG
AGRAL 90	non-ionic surfactant	nonylphenoxy polyethyoxyethanol	90%	2	C	NOR
AG-SURF	non-ionic surfactant	nonylphenoxy polyethyoxyethanol	92%	2	C	INT
AMIGO	surfactant	phosphate ester	30	2	C	AET
ASSIST OIL CONCENTRATE	mineral oil/surfactant (non herbicidal)	paraffin base mineral oil + surfactant blend	83% + 17%	3	C	BAZ
BASF LIQUID AMMONIUM SULPHATE	liquid fertilizer	ammonium sulphate	490 g/L	6	A	BAZ
BREAKER	antifoamer/defoamer			N/A	A	UAG
CANPLUS 411	mineral oil/surfactant (non herbicidal)	paraffin base mineral oil + surfactant blend	83% + 17%	6	C	ATC
CHOICE	water conditioning agent	polyacrylic, hydroxy carboxylic, propionic acids, phosphate ester & ammonium sulfate	50%	N/A	A	UAG
CITOWETT PLUS	non-ionic spreader sticker surfactant	ocylphenoxy-polyethoxy ethanol	50%	3	C	BAZ
COMPANION	non-ionic surfactant	ocylphenoxy-polyethoxy-(9) ethanol	70%	3	C	ROH
CO-OP EMULSIFIABLE SPRAY OIL	mineral oil (non herbicidal)	mineral oil + emulsifier	98.5% + 1.5%	3		INT
CORN OIL	mineral oil (non herbicidal)	paraffin base mineral oil + surfactant blend	98.8% + 1.2%		C	UAG
ENHANCE	cationic surfactant with non-ionic component	tallow fatty acid amine ethoxylate and nonylphenoxy-polyethoxy ethanol	780 g/L	2	A	DWE
FIGHTER F	antifoamer/defoamer	dimethylpolysiloxane		3		UAG
HALT	defoamer	silicone base, neutral	30%		A	DWE
IPCO OIL CONCENTRATE	mineral oil (non herbicidal)	paraffin base mineral oil + surfactant blend	83% + 17%	3	C	INT
KORNOIL	mineral oil (non herbicidal)	mineral oil + emulsifier	98.5% + 1.5%	3	C	VAR
KORNOIL CONCENTRATE	mineral oil/surfactant (non herbicidal)	paraffin base mineral oil + surfactant blend	85% + 15%	3	C	VAR
LI700	non-ionic surfactant & pH adjuster acidifier	phosphatidylcholine, methylacetic acid, alky polyoxyethylene ether	80%	3	C	UAG
MERGE	surfactant/solvent	surfactant blend + solvent (petroleum hydrocarbons)	50% + 50%	3	B	BAZ
NALCO-TROL	drift control agent	polyvinyl polymer	30%	3		NLC
SIDEKICK	non-ionic liquid spreader/activator	alkylarylpolyoxyethylene glycols, free fatty acids & isopropyl alcohol	900 g/L	3	C	NOR

TABLE 5 Adjuvants Used in Ontario

Brand and Trade Names* (see endnote)	Type of Adjuvant	Chemical Composition	Guaranteed Active	Ontario Schedule	Winter Storage	Manufacturer Agent Code
SPRAY ADJUVANT DEFOAMER	defoamer	demethylpoly-silozane				
SPRAYCO OIL CONCENTRATE	mineral oil/surfactant (non herbicidal)	paraffin base mineral oil + surfactant blend	85% + 15%	6	C	SWC
SPRAYCO PREMIUM MINERAL OIL	mineral oil (non herbicidal)	mineral oil + emulsifier	98.5% + 1.5%	6	C	SWC
SUPER SPREADER	non-ionic spreader sticker surfactant	ocylphenoxy-polyethoxy ethanol	50%	3	A	UAG
SUPERIOR OIL CONCENTRATE	mineral oil (non herbicidal)	paraffin base mineral oil + surfactant blend	83% + 17%	6		BAT, UAP, WBR
SURE-MIX	petroleum oil/ surfactant (non-herbicidal)	paraffinic petroleum oil + surfactant blend	60% + 35.6%	6	A	DUQ
SURF 92	non-ionic surfactant	nonylphenoxy polyethyoxyethanol	92%	2	C	WBR
SYLGARD 309	organosilicone, non-ionic	silicone polyether	76%	3	C	DCS
TREKKER TRAX	foam marker	alchohols, mixed anionic & nonionic surfactants	54%	N/A	A	UAG
TURBOCHARGE	mineral oil/surfactant (non herbicidal)	paraffin base mineral oil + surfactant blend	50% + 39.5%	3	C	SYN
UNITE	compatibility agent	acid polyglycols & methyl alcohol	83.70%		A	UAG
XA OIL CONCENTRATE	mineral oil/surfactant (non herbicidal)	paraffin base mineral oil + surfactant blend	83% + 17%	6	A	UAG

Mention of a Brand or Trade name in this table does not constitute a guarantee or warranty of the product by the Ontario Weed Committee. Neither does this use signify that these products are approved to the exclusion of comparable products. All trade names are capitalized.

Active Ingredient TRADE NAME (Formulation	RATE (active) PRODUCT PER HA	RATE PRODUCT/ PER ACRE	PRECAUTIONS (For more information, see Chapter 4: Notes on Herbicides and Chapter 5: Notes on Adjuvants)
Preplant-Site Preparation Prior To Any Crop			
amitrole AMITROL 240 (231g/L)	1 to 2 kg/ha 4.2 to 8.4 L/ha	1.68 to 3.36 L/ac	• For dandelions and annual weeds. • For corn, soybeans, white beans, wheat, barley, canola and field peas. • Apply in 100–200 L/ha water (40–180 L/ac) 10–14 days before planting the crop. • Wait 10–14 days before tillage and planting (**ONLY** soybeans may be planted 6 days after application when applied at the low rate). • Use additional herbicide treatments to control weed species that emerge after application. • May be tank-mixed with ROUNDUP or PURSUIT where registered.
amitrole AMITROL 240 (231 g/L)	3 to 4 kg/ha 12.5 to 16.5 L/ha	5 to 6.6 L/ac	• For quackgrass, Canada thistle, sow thistle (fall treatment) and annual weeds. • For use **ONLY** before white beans, corn and soybeans. • Apply in 100–200 L/ha water (40–180 L/ac). • Apply to actively growing weeds up to 10 cm tall in the fall (until heavy frost) or in spring. • Plow or thoroughly disk 10–14 days after application. • Cultivation may be required when the crop is emerged to improve weed control.

glyphosate*
glyphosate (360 g/L)
 	
* Various formulations are available, see Table 1. See label for specific uses and rates.
	0.27 to 4.32 kg/ha
	0.75 to 12 L/ha
		0.3 to 4.8 L/ac	• For actively growing weeds in the fall, or spring prior to emergence of any crop.
			• Allow 5–7 days translocation time after application before doing any tillage when conditions are good. If cool temperatures follow application, allow additional time for translocation to be completed before disturbing treated weeds.
			• Only weeds emerged at application time will be controlled. Additional weed control programs will be necessary to control weeds germinating later.
			• Repeat application to regrowth may be necessary for complete control.
			• For **annual weeds**, use 0.75 to 3.5 L product/ha (0.3 to 1.4 L/ac).
			  • Use 50–100 L/ha water (20–40 L/ac) for the low rate, or use a surfactant with larger water volumes.
			  • Water volumes of 100–300 L/ha water (40–120 L/ac) can be used with the 3.5 L rate.
			• For **dandelions and quackgrass**, use 2.5 to 7 L product /ha (1–2.8 L/ac).
			  • Apply when plants have at least 3–4 new leaves.
			  • The low rate (2.5 L/ha (1 L/ac)) will provide a minimum of one season control while higher rates (4.75 to 7 L/ha (1.9 to 2.8 L/ac)) will provide longer term control.
			  • For dandelion control apply 2.5 L/ha (1 L/ac) if 15 cm or less in diameter and 3.5–5 L/ha (1.4–2 L/ac) if larger than 15 cm.
			• For **perennial broadleaf weeds**, use 7 to 12 L product/ha (2.8 to 4.8 L/ac)
			  • Canada thistle and sow-thistle should be at least in early bud, milkweed at bud, bindweed at full flower, and dogbane past full bloom for best results.
			  • For undisturbed perennials such as sod in non-crop areas, use the highest rate and repeat it when plants regrow to optimum stage.

glyphosate/glufosinate ammonium ROUNDUP FASTFORWARD PRESEED ((30:1) 310 g/L)	0.465 to 2.604 kg/ha 1.5 to 8.4 L/ha	0.6 to 3.4 L/ac	▪ For annual grasses up to 15 cm tall, use 0.6 L/ac. ▪ For annual grass and broadleaf weeds up to 15 cm tall, use 1.1 L/ac. ▪ For annual weeds over 15 cm tall, use 1.7 L/ac. ▪ For quackgrass, use 1.5 L/ac. ▪ For dandelions less than 15 cm, use 2 L/ac. ▪ For heavier infestations and for dandelions larger than 15 cm, use 3.4 L/ac.
paraquat GRAMOXONE (200 g/L)	0.55 to 1.1 kg/ha 2.75 to 5.5 L/ha	1.1 to 2.2 L/ac	▪ Apply to actively growing vegetation at least 3 days prior to crop emergence. ▪ Use the high rate when weeds are above 5 cm in height. ▪ Apply in 300–1100 L/ha water (120–440 L/ac). ▪ Complete coverage is important. Use higher water volumes on dense vegetation. ▪ Perennial weeds will only be suppressed. ▪ Only emerged weeds will be controlled.

Stale Seedbed and Inter-Row Weeding

The stale seedbed technique is useful when the soil can be worked well before planting, and weeds are allowed to emerge for several weeks. Apply one of the non-selective postemergent herbicides listed here to kill emerged weeds. Seeding or planting directly into the killed weeds with minimal soil disturbance will allow the crop to establish before the next flush of weed emergence. Follow up with either cultivation, hoeing or postemergent or directed herbicides to control later germinating weeds. Where registered, some herbicides can be applied after seeding but before crop emergence.

glufosinate ammonium IGNITE (150 g/L)	0.405 to 0.75 kg/ha 2.7 to 5 L/ha	1.08 to 2 L/ac	▪ For use **ONLY** in carrot, lettuce and onion crops. ▪ Apply in a minimum of 110–330 L/ha (44–132 L/ac) of water. ▪ Apply after seeding, but prior to emergence of the crop.
glyphosate* glyphosate (360 g/L) * Various formulations available, see Table 1. See label for specific uses and rates.	0.27 to 1.26 kg/ha 0.75 to 3.5 L/ha	0.3 to 1.4 L/ac	▪ Till and fertilize soil in early spring. ▪ Allow weeds to grow, and spray weeds just before seeding crop. ▪ Use low rate for small weeds (8 cm), medium rates for weeds 8 to 15 cm and higher rate for weeds over 15 cm tall. ▪ Apply recommended herbicides to control new flushes of weeds or use mechanical means of control.
glyphosate/glufosinate ammonium ROUNDUP FASTFORWARD PRESEED ((30:1) 310 g/L)	0.465 to 2.604 kg/ha 1.5 to 8.4 L/ha	0.6 to 3.4 L/ac	▪ For annual grasses up to 15 cm tall, use 0.6 L/ac. ▪ For annual grass and broadleaf weeds up to 15 cm tall , use 1.1 L/ac. ▪ For annual weeds over 15 cm tall, use 1.7 L/ac. ▪ For quackgrass, use 1.5 L/ac. ▪ For dandelions less than 15 cm, use 2 L/ac . ▪ For heavier infestations and for dandelions larger than 15 cm, use 3.4 L/ac.
paraquat GRAMOXONE (200 g/L) or diquat REGLONE (200 g/L)	0.6 to 1.1 kg/ha 3 to 5.5 L/ha 0.6 to 1.1 kg/ha 3 to 5.5 L/ha	1.2 to 2.2 L/ac 1.2 to 2.2 L/ac	▪ For emerged weeds after the crop seed is sown, but before crop emergence. ▪ For use **ONLY** in beans (all types), beets, carrots, cole crops, corn, onions, peas, cucumbers, potatoes, soybeans and turnips. ▪ In inter-row weeding, special low pressure equipment is used to apply the herbicide on emerged weeds without contact with leaves of the crop plants. ▪ For small areas, apply 30 mL product in 10 L water per 100 m^2.
paraquat/ diquat C.I.L.WEED & GRASS KILLER WEED-BAN	See Label		▪ **Domestic** — Soluble granular formulations for home garden use. Check label for rates.

Active Ingredient TRADE NAME (Formulation	RATE (active) PRODUCT PER HA	RATE PRODUCT PER ACRE	PRECAUTIONS (For more information see Chapter 4 Notes on Herbicides and Chapter 5 Notes on Adjuvants)
Postharvest (Broadleaf Herbicides)			
2,4-D ESTASOL (564 g/L) ESTER 600 (564 g/L) ESTER 700 (660 g/L)	0.85 to 1.555 kg/ha 1.5 to 2.75 L/ha 1.5 to 2.75 L/ha 1.29 to 2.36 L/ha	 0.6 to 1.1 L/ac 0.6 to 1.1 L/ac 0.52 to 0.94 L/ac	▪ Apply in the fall at the time of rapid growth. ▪ Use the higher rate for legumes and perennial weeds. ▪ For best results apply to actively growing vegetation at least 2 weeks before a killing frost. ▪ **Do NOT** apply before fall wheat or barley.
2,4-D/ dicamba/ mecoprop KIL-MOR (485 g/L)	0.534 to 0.849 kg/ha 1.1 to 1.75 L/ha	 0.44 to 0.7 L/ac	▪ Ground application **ONLY**. ▪ **Do NOT** apply if wind velocity exceeds 8 km/hr. ▪ Apply in 200 L/ha water (80 L/ac).
dicamba BANVEL II (480 g/L)	1.2 kg/ha 2.5 L/ha	 1 L/ac	▪ Apply in the fall to actively growing vegetation at least 2 weeks prior to a killing frost. ▪ **Do NOT** apply before fall seeded crops. ▪ **ONLY** cereals, soybeans, field corn, sweet corn or white beans may be grown year after application.
Postharvest (Grass and Broadleaf Herbicides)			
amitrole AMITROL 240 (231 g/L)	3 to 4 kg/ha 12.5 to 16.5 L/ha	 5 to 6.6 L/ac	▪ Apply after harvest when regrowth is 10 to 15 cm tall for Canada thistle and sow-thistle. ▪ **Do NOT** cultivate for 2 weeks after application. ▪ **Do NOT** apply after a heavy frost, generally after Oct. 1. ▪ **Do NOT** plant to a crop for 8 months after treatment.
dicamba BANVEL II (480 g/L) plus glyphosate ROUNDUP (356 g/L) plus non-ionic surfactant	0.6 kg/ha 1.25 L/ha 0.6 kg/ha 1.7 L/ha 0.35 L/ha	 0.5 L/ac 0.68 L/ac 0.14 L/ac	▪ Apply in the fall to actively growing vegetation at least 2 weeks prior to a killing frost. ▪ **Do NOT** apply before fall seeded crops.

glyphosate*
glyphosate (360 g/L)
	0.27 to 4.32 kg/ha
	0.75 to 12 L/ha
		
		0.3 to 4.8 L/ac
			▪ For actively growing weeds in the fall, or spring prior to emergence of any crop.
			▪ Allow 5 to 7 days translocation time after application before doing any tillage when conditions are good. If cool temperatures follow application, allow additional time for translocation to be completed before disturbing treated weeds.
			▪ Only weeds emerged at application time will be controlled. Additional weed control programs will be necessary to control weeds germinating later.
			▪ Repeat application to regrowth may be necessary for complete control.
			▪ For **annual weeds**, use 0.75 to 3.5 L product/ha (0.3 to 1.4 L/ac).
			  ▪ Use 50–100 L/ha water (20–40 L/ac) for the low rate, or use a surfactant with larger water volumes.
			  ▪ Water volumes of 100 to 300 L/ha water (40–120 L/ac) can be used with the 3.5 L rate.
			▪ For **dandelions and quackgrass**, use 2.5 to 7 L product /ha (1 to 2.8 L/ac).
			  ▪ Apply when plants have at least 3 to 4 new leaves.
			  ▪ The low rate (2.5 L/ha (1 L/ac)) will provide a minimum of one season control while higher rates (4.75–7 L/ha (1.9–2.8 L/ac)) will provide longer term control.
			  ▪ For dandelion control apply 2.5 L/ha (1 L/ac) if 15 cm or less in diameter and 3.5–5 L/ha (1.4–2 L/ac) if larger than 15 cm.
			▪ For **perennial broadleaf weeds**, use 7 to 12 L product/ha (2.8 to 4.8 L/ac).
			▪ Canada thistle and sow-thistle should be at least in early bud, milkweed at bud, bindweed at full flower, and dogbane past full bloom for best results.

* Various formulations available, see Table 1. See label for specific uses and rates.

			• For undisturbed perennials such as sod in non-crop areas, use the highest rate and repeat it when plants regrow to optimum stage.
Spot Treatment with Hand-Held Equipment For Selective Weed Control			
amitrole AMITROL 240 (231 g/L)	3 to 4 kg/ha 12.5 to 16.5 L/ha	5 to 6.6 L/ac	• Use **ONLY** for non-crop land and pasture. • Thoroughly wet all leaves and stems of weeds. Repeat applications when new growth appears. • Apply to Canada thistle and sow-thistle at early bud to bloom, quackgrass and horsetail at 10–15 cm, dandelion when young, toadflax and hoary cress at advanced rosette, milkweed in early summer, poison ivy when fully leafed. • **Do NOT** allow livestock to eat treated vegetation. Keep livestock off treated area until weeds are dead and new growth has emerged.
glyphosate EXPEDITE GRASS & WEED (147 g/L)	0.88 to 4.265 kg/ha 6 to 29 L/ha	2.4 to 11.6 L/ac	• EXPEDITE herbicides are ready-to-use products which must be applied with the EXPEDITE application system. • This low volume application should not be applied "spray to wet" or runoff. • Material should be calibrated for proper use rate prior to application.
glyphosate* glyphosate (360 g/L) * Various formulations available, see Table 1. See label for specific uses and rates.	0.36 kg to 0.72/100 L 1 L to 2 L/100 L		• For actively growing weeds. Direct spray to avoid desirable vegetation. • Allow 5–7 days translocation time after application before doing any mowing or tillage when conditions are good. If cool temperatures follow application, allow additional time for translocation to be completed before disturbing treated weeds. • Canada thistle and sow-thistle should be at least in early bud, milkweed at bud, bindweed at full flower, and dogbane past full bloom, and quackgrass with 3–4 new leaves for best results.
Wick Wiper and Roller Application			
glyphosate* glyphosate (360 g/L) * Various formulations available, see Table 1. See label for specific uses and rates.	0.36 kg/2 L water 1 L/2 L water		• For use on soybeans, white beans, apple, cherry, peach, pear, plum, grape, strawberries and cranberries. • Apply to weeds that extend above the crop sufficiently to allow good contact with the application equipment. • **Do NOT** contact the crop with the equipment or allow the chemical solution to drip from the applicator on to the crop. • A 33% herbicide mixture (1 L/2 L of water) provides good control of most weeds.
Seedbeds and Potting Soil: Soil Applied Fumigants			
To convert kg/ha or L/ha to g/ha or mL/100 m²: Multiply by 10 and change units to 100 m². **Example:** 11 kg/ha becomes 110 g/100 m²; 28.4 L/ha becomes 284 mL/100 m²			
dazomet BASAMID (98 Gr)	500 kg/ha 510 kg/ha	204 kg/ac	• **Do NOT** use below 6°C. • Refer to manufacturer's directions for specific details as well as directions on sealing soil, evacuating gases and performing the safety germination test.
metam sodium VAPAM (380 g/L)	3.8 kg/100 m² 10 L/100 m² in 800 L water		• Apply as a drench to a soil that should be wet to a depth of at least 8 cm. • **Do NOT** plant for 10–14 days or longer if the weather is cool.

Active Ingredient TRADE NAME Formulation	RATE (active) PRODUCT PER HA	RATE PRODUCT PER ACRE	PRECAUTIONS For more information see Chapter 4 Notes on Herbicides and Chapter 5 Notes on Adjuvants
methyl bromide/ chloropicrin TERR-O-GAS 67 (67 Li)			• A poisonous gas which must be applied under a gas proof cover (usually plastic). • Its use is subject to the *Pesticides Act*. • It may be used by the grower on his own seedbeds but he must obtain a permit from the Ontario Ministry of the Environment each time it is used. • The manufacturer's instructions must be followed, and the seedbed or greenhouse aired thoroughly after the treatment period. • If there is any question, the safety precautions in the *Pesticides Act* should be studied, or inquiry made at the resource centres of the Ontario Ministry of Agriculture, Food and Rural Affairs or the Ontario Ministry of the Environment.

* Various formulations available, see Table 1. See label for specific uses and rates.

TABLE 6. Non Selective Herbicides Available for Preplant Site Preparation

CROP	AMITROL 240	BASAMID	GRAMOXONE	IGNITE	REGLONE	CREDIT, GLYFOS, ROUNDUP, TOUCHDOWN, VANTAGE	VAPAM
corn	X				X	X	
soybeans	X				X	X	
white beans	X					X	
stale seedbed field crops			X			X	
tobacco						X	X
zero tillage corn			X			X	
field vegetable seedbeds		X				X	X
stale seed beds			X			X	
asparagus				X		X	
beans					X	X	
beets				X	X	X	
carrots				X	X	X	
celery						X	
cole crops					X	X	
corn					X	X	
cucumber					X	X	
eggplant		X				X	
ginseng						X	
lettuce		X		X		X	
melons						X	
onions				X	X	X	
peas					X	X	
peppers		X				X	
potatoes					X	X	
rutabaga					X	X	
squash						X	
tomato		X				X	
fruit						X	X
berries						X	
woody nursery stock		X				X	X
herbaceous ornamentals seed & planting beds		X				X	
turf seedbeds		X				X	
turf renovation			X			X	

Notes:

Weed control ratings are given as 0–9 where 0 indicates no control and 9 indicates 90%–100% control under ideal conditions.

Ratings are subjective values based on best available information and give general comparisons based on use as described in this guide.

Under unfavorable conditions (eg., too dry, too wet, too cold, or poor application) the herbicides may not be as effective as indicated.

Ratings may vary with weed and crop stage and with the timing and rates of the product(s) being used.

Ratings in **BOLD** indicate the weed is listed on the product label for control or suppression.

Please see product label for more information on registered weed species, product uses and precautions.

TABLE 7 Preplant Herbicide Weed Control Ratings

Trade Name	Annuals		Perennials														
	annual grasses	annual broadleaves	bindweed, field	chickweed, mouse-eared	dandelion	golden-rod	ground-ivy (creeping Charlie)	horsetail	mallow	milkweed	nutsedge	plantains	poison ivy	quackgrass	sow-thistle	thistle, Canada	vetches
AMITROL 240	**	**	[a]	?	**9**	[a]	?	7	?	[a]	[a]	8	8	**7**	[a]	**7**	?
CREDIT, GLYPHOS, ROUNDUP, TOUCHDOWN, VANTAGE	**	**	**7**[a]	**9**	**7/8**[d]	?	5	0	5	[a]	**7**	**9**	**8**	**8/9**	[a]	**7**[a]	5
IGNITE	**	**	8[c]	?	**8**	?	?	7[c]	?	6[c]	7[c]	?	?	8[c]	8[c]	8[c]	?
GRAMOXONE	**	**	[b]	[b]	[b]	?	[b]	[b]	[b]	[b]	0	[b]	[b]	**5**	[b]	0	[b]

** Indicates that most annual weeds will be controlled if emerged.

? Insufficient information available to make a rating

[a] Optimum growth stages for best control of these weeds will not likely be attained prior to planting in early to mid spring.

[b] Top growth only, regrowth can be expected.

[c] Repeated applications may be necessary.

[d] Use higher rates for plants over 15 cm tall or across.

Notes:

Weed control ratings are given as 0–9 where 0 indicates no control and 9 indicates 90%–100% control under ideal conditions.

Ratings are subjective values based on best available information and give general comparisons based on use as descibed in this guide.

Under unfavourable conditions (eg., too dry, too wet, too cold, or poor application) the herbicides may not be as effective as indicated.

Ratings may vary with weed stage and with the timing and rates of the product(s) being used.

Ratings in **BOLD** indicate the weed is listed on the product label for control or suppression.

Please see product label for more information on registered weed species, product uses and precautions.

TABLE 8. Postharvest Weed Control

Crop Stubble	Treatment	Grasses		Perennial Broadleaf Weeds								
		quackgrass	wire stem muhly	field bindweed	chickweed, mouse-eared	coltsfoot	dandelion	hemp dogbane	milkweed	ground cherry	canada thistle	sow thistle
Postharvest herbicides												
glyphosate	CREDIT, GLYPHOS, ROUNDUP, TOUCHDOWN, VANTAGE	**9**	**9**	**9**	**9**	**8**	**8/9[a]**	**8**	**8**	?	**9**	**9**
dicamba	BANVEL II	0	0	**8**	9	7	8	8	7	6	**8**	9
2,4-D/ mecoprop/ dicamba	KILMOR	0	0	**8**	9	?	8	2	0	?	**7**	8
2,4-D	2,4-D *	0	0	**7**	2	?	**7**	?	0	?	**6**	**7**

? Insufficient information available to make a rating

* various products available, see Table 1

[a] Use higher rates for weeds larger than 15 cm tall or across

CHAPTER 7. BEANS

Beans (Dry, Lima and Snap)

Dry Beans include adzuki, black, cranberry, Dutch brown, kidney, pinto, yellow eye and white bean market classes.

All treatments should be applied in 150–300 L/ha (60–120 L/ac) water unless otherwise specified.

Cultivation, rotation and other cultural practices are effective weed control techniques that should be considered along with herbicide treatments when developing a weed control program. Any single method of weed control or the continuous use of the same chemical can lead to the build up of weeds resistant or tolerant to that control method. Rotation to other crops and/or other control methods will reduce the chance of developing new or unique weed infestations.

High speed (10–20 km/hr) shallow (2.5–3 cm) cultivation with a rotary hoe when the beans are in the 1–2 leaf stage will help to control small weed seedlings. This technique will not reduce herbicide action and may in some years enhance chemical weed control and improve crop safety.

Inter-row cultivation may be required when weeds escape herbicide treatment; weeds should be considered as escapes when they are 5–7 cm high. Cultivation should be shallow to prevent exposure of untreated soil and germination of new weed seeds.

Band treatment of chemical over the row will reduce costs by one-half to two-thirds, depending on the row spacing and width of band. Shallow inter-row cultivation will be required to control weeds between the bands.

Cultivation will give some control of established perennial weeds but may also help to spread them to previously uninfested areas. Machinery sanitation is important when moving from one field to another.

Many perennials can be spread on tillage equipment. Where possible it is always a good idea to till fields with perennial weeds last. Custom operators should be particularly careful when moving from one farm to another. For additional information see the section on preventative weed control in this publication.

Some chemicals may also be impregnated on dry bulk fertilizer. Check the label for recommended fertilizer ingredients. Please refer to Beans (Dry, Lima and Snap) Weed Control Ratings Table to determine which market classes of edible beans are registered for the herbicide treatments listed.

Rates and application techniques vary for trifluralin products. For further information on these and other chemicals refer to label recommendations and also the "Notes on Chemicals" section in this publication.

Soil Applied Treatments include

- **Preplant (PP)** — Also see Chapter 6, **Special Methods: Preplant — Site Preparation** for details of products, rates and remarks.
- **Preplant incorporated (PPI)** — Two incorporations at right angles operating at a depth of 10 cm using a double disk (7–10 km/hr) or vibrating shank S-tine cultivator (10–13 km/hr) are required unless otherwise stated. Cultivation-type equipment used for herbicide incorporation is known to spread perennial weeds to previously uninfested areas. Special attention should be directed toward machinery cleanliness, and/or treating fields with perennial weeds last.
- **Preemergence (PRE)** — Rainfall of 15–20 mm within 10 days after application is necessary to activate preemergence treatments. Shallow cultivation, rotary hoeing or harrowing will control weed escapes and improve herbicide activity in the absence of rainfall.

Postemergence (POST) — Leaf stage of the weeds is critical for good weed control. Smaller weeds are usually more sensitive to herbicide injury. Apply according to recommended leaf stages. Crop stage is important to optimize crop safety. Adjuvants will frequently improve the weed control when used as directed. Weather or other conditions may influence the optimum rate of adjuvant, see the product label for more details. Always use appropriate drift management technology.

Active Ingredient TRADE NAME (Formulation)	RATE (active) PRODUCT PER HA	RATE PRODUCT PER ACRE	PRECAUTIONS (For more information, see "Notes on Chemicals" section.)
Soil Applied Grass Herbicides			
dimethenamid FRONTIER (900g/L)	1 to 1.25 kg/ha 1.1 to 1.4 L/ha	0.44 to 0.56 L/ac	▪ Apply PPI or PRE. ▪ USE **ONLY** ON white and kidney beans. ▪ **DO NOT** use on muck, peat or high organic matter soils. ▪ Minimum PPI rate is 1.4 L/ha (0.5 L/ac). ▪ Control of yellow nutsedge is obtained when FRONTIER is applied PPI. ▪ Use the higher rate of FRONTIER for the control of nightshade and pigweed.
EPTC EPTAM (800g/L)	3.4 to 4.4 kg/ha 4.25 to 5.5 L/ha	1.7 to 2.2 L/ac	▪ Apply PPI. Incorporate immediately. ▪ **DO NOT** use on adzuki and lima beans. ▪ If dry weather has preceded the application of EPTC, delay seeding 7–10 days. ▪ Temporary injury can occur in the emerging crop. ▪ Use the high rate for nutsedge control.
EPTC EPTAM (800g/L) plus trifluralin TREFLAN EC (480g/L) RIVAL (500g/L) BONANZA 400 (400g/L)	2.4 kg/ha 3 L/ha 0.6 kg/ha 1.25 L/ha 1.2 L/ha 1.5 L/ha	1.2 L/ac 0.5 L/ac 0.48 L/ac 0.6 L/ac	▪ Apply PPI. Incorporate immediately. ▪ USE **ONLY** ON white and red kidney beans. ▪ If dry weather has preceded the application of EPTC, delay seeding 7–10 days.
s-metolachlor DUAL MAGNUM (915g/L)	1.05 to 1.6 kg/ha 1.15 to 1.75 L/ha	0.44 to 0.7 L/ac	▪ Apply PPI. ▪ **DO NOT** use on adzuki, black, brown, cranberry or yellow-eye beans. ▪ **DO NOT** use on muck, peat or high organic matter soils. ▪ Control of yellow nutsedge is obtained when DUAL MAGNUM is applied PPI. ▪ Use the higher rate for heavier weed populations.
trifluralin TREFLAN EC (480g/L) RIVAL (500g/L) BONANZA 400 (400g/L)	0.6 to 1.155 kg/ha 1.25 to 2.4 L/ha 1.2 to 2.3 L/ha 1.5 to 275 L/ha	 0.5 to 0.96 L/ac 0.48 to 0.92 L/ac 0.6 to 1.1 L/ac	▪ Apply PPI. Incorporate as soon as possible. Within 24 hrs. ▪ **DO NOT** use on adzuki, brown, cranberry, pinto and yellow-eye beans. ▪ **Do NOT** exceed 1.2 L/ha (0.48 L/ac) of TREFLAN on medium textured soils and 1.7 L/ha (0.68 L/ac) in heavy textured soils for lima beans.
Soil Applied Broadleaf Herbicides			
metobromuron PATORAN FL (400g/L)	1 to 1.7 kg/ha 2.5 to 4.25 L/ha	1 to 1.7 L/ac	▪ Apply PRE. ▪ **DO NOT** use on black, brown, cranberry or yellow-eye beans. ▪ **DO NOT** exceed 3.0 L/ha for kidney beans or snap beans. ▪ Use the low rate when applied sequentially after a PPI treatment. ▪ Beans should be seeded at least 5 cm deep. Shallow planted crops may be injured if heavy rains follow application. ▪ Injury may occur if beans are under stress, or from treated soil having been splashed up onto the leaves by a rainstorm. ▪ A shallow harrowing or rotary hoeing after application of the chemical will reduce the possibility of splash up as well as help activate the chemical if dry weather follows application.

Active Ingredient TRADE NAME (Formulation)	RATE (active) PRODUCT PER HA	RATE PRODUCT PER ACRE	PRECAUTIONS (For more information, see "Notes on Chemicals" section.)
monolinuron AFESIN (200g/L)	0.75 to 1.4 kg/ha 3.75 to 7 L/ha	1.5 to 2.8 L/ac	▪ Apply PRE. ▪ **DO NOT** use on adzuki, black, brown, cranberry or pinto beans. ▪ **DO NOT** use on soils with less than 3% organic matter. ▪ Use the low rate when applied sequentially after a PPI treatment . ▪ Beans should be seeded at least 5 cm deep. Shallow planted crops may be injured if heavy rains follow application. ▪ Injury may occur if beans are under stress, or from treated soil having been splashed up onto the leaves by a rainstorm. ▪ A shallow harrowing or rotary hoeing after application of the chemical will reduce the possibility of splash up as well as help activate the chemical if dry weather follows application.
Soil Applied Grass and Broadleaf Herbicides			
imazethapyr PURSUIT (240g/L)	0.075 kg/ha 0.312 L/ha	0.125 L/ac	▪ Apply PPI for use on white beans only. ▪ Apply RE on black, brown, cranberry, kidney, snap, yelloweye and white beans. ▪ **DO NOT** apply on lima and pinto beans ▪ Apply once per season. ▪ **DO NOT** harvest within 100 days of application. ▪ **Some rotational cropping restrictions apply (see Table 2).**
imazethapyr PURSUIT (240g/L) plus trifluralin TREFLAN EC (480g/L) RIVAL (500 g/L) BONANZA 400 (400g/L)	0.075 kg/ha 0.312 L/ha 0.6 to 1.15 kg/ha 1.25 to 2.4 L/ha 1.2 to 2.3 L/ha 1.5 to 2.75 L/ha	0.125 L/ac 0.5 to 0.96 L/ac 0.48 to 0.92 L/ac 0.6 to 1.1 L/ac	▪ Apply PPI and incorporate as soon as possible. Incorporate within 24 hr. ▪ USE **ONLY** ON white beans. ▪ **Some rotational cropping restrictions apply (see Table 2).**
imazethapyr PURSUIT (240g/L) plus metobromuron PATORAN FL (400g/L)	0.075 kg/ha 0.312 L/ha 1 to 1.2 kg/ha 2.5 to 3 L/ha	0.125 L/ac 1 to 1.2 L/ac	▪ Apply PRE. ▪ USE **ONLY** ON kidney and white beans. ▪ Beans should be seeded at least 5 cm deep. Shallow planted crops may be injured if heavy rains follow application. ▪ Injury may occur if beans are under stress or from treated soil having been splashed up onto the leaves by a rainstorm. ▪ A shallow harrowing or rotary hoeing after application of the chemical will reduce the possibility of splash up as well as help activate the chemical if dry weather follows application. ▪ **Some rotational cropping restrictions apply (see Table 2).**
Postemergence Grass Herbicides			
clethodim SELECT (240g/L) plus surfactant AMIGO	0.03 to 0.046 kg/ha 0.125 to 0.19 L/ha 5 L/1000L	0.05 to 0.076 L/ac	▪ Apply POST when annual grasses and volunteer cereals are in the 1–6 leaf stage. ▪ USE **ONLY** ON black beans and pinto beans. ▪ **DO NOT** apply if rain is expected within one hr after application.
diclofop-methyl HOE-GRASS 284 (284g/L)	1 kg/ha 3.5 L/ha	1.4 L/ac	▪ Apply POST when annual grasses are in the 1–4 leaf stage (2-3 is optimum). ▪ USE **ONLY** ON kidney, lima, snap and white beans. ▪ **DO NOT** apply if rain is expected within one hr after application.
fenoxaprop-p-ethyl EXCEL SUPER (80.5g/L)	0.054 kg/ha 0.67 L/ha	0.27 L/ac	▪ Apply POST when annual grasses are in the 2–5 leaf stage. ▪ USE **ONLY** ON kidney, snap and white beans. ▪ **DO NOT** apply if rain is expected within one hr after application.

quizalofop-p-ethyl ASSURE II (96g/L) plus oil concentrate CANPLUS 411 or SURE-MIX	0.036 to 0.07 kg/ha 0.38 to 0.75 L/ha 5 to 10 L/1000L 5 L/1000L	 0.15 to 0.3 L/ac 5 to 10 L/1000L 5 L/1000L	▪ Apply to emerged annual grasses and volunteer cereals in 2 leaf to tillering stage and volunteer corn and quackgrass in the 2–6 leaf stage. ▪ Use the 0.38 L/ha (0.15 L/ac) rate of ASSURE II for control of volunteer corn, volunteer cereals and green foxtail. ▪ The 0.5 L/ha (0.2 L/ac) rate of ASSURE II will suppress quackgrass and also control barnyard grass. ▪ Use the 0.75 L/ha (0.3 L/ac) rate of ASSURE II for control of quackgrass. ▪ Use the higher rate of CANPLUS 411 or SURE-MIX when wild oats and quackgrass are the target weeds or under drought conditions. ▪ Registered for use on **snap beans only.**
sethoxydim POAST ULTRA (450g/L) plus surfactant MERGE	0.15 to 0.5 kg/ha 0.32 to 1.1 L/ha 1 to 2 L/ha	 0.13 to 0.45 L/ac 0.4 to 0.8 L/ac	▪ Apply POST when annual grasses and volunteer cereals are in the 1–6 leaf stage and quackgrass is in the 1-3 leaf stage. ▪ **DO NOT** use on black, brown, cranberry or yellow-eye beans. ▪ Maximum rate on snap beans is 0.65 L/ha (0.26 L/ac). ▪ Use the intermediate rate (0.47 L/ha) for volunteer spring cereals. ▪ Use the high rate (1.1 L/ha) for quackgrass. ▪ Thorough preplant tillage will ensure more uniform quackgrass emergence. Follow with a cultivation 7 days after treatment in wide row crops. ▪ **DO NOT** apply if rain is expected within one hr after application.
Postemergence Broadleaf Herbicides			
bentazon BASAGRAN (480g/L) plus fomesafen REFLEX (240 g/L) plus oil concentrate ASSIST	0.84 kg/ha 1.75 L/ha 0.14 kg/ha 0.58 L/ha 2 L/ha	 0.7 L/ac 0.23 L/ac 0.8 L/ac	▪ Apply POST when beans are in the 1–2 trifoliate leaf stage. ▪ USE **ONLY** ON white and kidney beans. ▪ Refer to the BASAGRAN label and the REFLEX label for information on specific weed stage and height. ▪ **DO NOT** apply if rain is expected within 6 hr. after application.
Bentazon BASAGRAN FORTÉ (480g/L) or BASAGRAN (480g/L) plus oil concentrate ASSIST	0.84 to 1.08 kg/ha 1.75 to 2.25 L/ha 1.75 to 2.25 L/ha 2 L/ha	 0.7 to 0.9 L/ac 0.7 to 0.9 L/ac 0.8 L/ac	▪ Apply POST when beans are in the unifoliate to 4 trifoliate leaf stage. ▪ **DO NOT** use BASAGRAN on adzuki beans. ▪ USE BASAGRAN FORTE ONLY ON white and kidney beans. ▪ Apply when weeds are small and actively growing. ▪ Two applications of 1.75 L/ha (0.7 L/ac) 10 days apart may be required to control the perennial weeds. ▪ No adjuvant is required with BASAGRAN FORTÉ. ▪ **DO NOT** apply if rain is expected within 6 hr. after application.
fomesafen REFLEX (240 g/L) plus adjuvant AGRAL 90	0.24 kg/ha 1 L/ha 2.5 L/1000L	 0.4 L/ac 2.5 L/1000L	▪ **DO NOT** use on adzuki beans. ▪ Apply POST when beans are in the 1-2 trifoliate leaf stage. ▪ Apply when weeds are small and actively growing. ▪ Apply in 200-350 L water/ha (80-140 L/ac water). ▪ **DO NOT** apply if rain is expected within 4 hr. after application. ▪ **DO NOT** apply REFLEX to any field more often than once every 2 yr. ▪ **DO NOT** apply to crop under stress. ▪ Some rotational cropping restrictions apply. ▪ **DO NOT** harvest within 93 days of application.

Active ingredient TRADE NAME (Formulation)	RATE (active) PRODUCT PER HA	RATE PRODUCT PER ACRE	PRECAUTIONS (For more information see "Notes on Chemicals" section)
Postemergence Grass and Broadleaf Herbicides			
fenoxaprop-p-ethyl EXCEL SUPER (80.5 g/L) plus bentazon BASAGRAN (480 g/L) plus oil concentrate ASSIST	0.054 kg/ha 0.67 L/ha 0.84 to 1.08 kg/ha 1.75 to 2.25 L/ha 2 L/ha	 0.27 L/ac 0.7 to 0.9 L/ac 0.8 L/ac	• Apply POST when beans are in the unifoliate to 4 trifoliate leaf stage and annual grasses are in the 2–5 leaf stage. • USE **ONLY** ON kidney, snap and white beans. • Temporary crop injury may occur under abnormally hot, humid conditions. Reduce the oil concentrate to 1 L/ha (0.4 L/ac) when these conditions occur. Apply when weeds are small and actively growing. • Refer to the BASAGRAN label for information on specific weed stage and height. • If broadleaf and grass weeds are not in the correct leaf stage for a tank-mix application, use a split application at the correct stage for each product. • **DO NOT** apply if rain is expected within 6 hr. after application.
Preharvest			
diquat REGLONE DESICCANT (240 g/L) plus surfactant AGRAL 90 or AG-SURF	0.3 to 0.55 kg/ha 1.25 to 2.3 L/ha 1 L/1000 L	 0.5 to 0.92 L/ac 1 L/1000 L	• Apply Preharvest when 80% natural leaf defoliation and 80% of the pods have turned yellow. • **DO NOT** use on lima or snap beans. • Avoid regrowth by targeting spray within 7 days of bean variety maturity date and harvest 5–7 days after application. • Use 1.25 to 1.7 L/ha by ground and 1.7 to 2.3 L/ha for aerial applications. • Use a minimum of 225 L/ha of spray volume. • Use the higher rate for heavy canopy of crop or weeds. • **DO NOT** apply if rain is expected within 15 minutes after application.
glufosinate ammonium IGNITE (150 g/L)	0.37 to 0.45 kg/ha 2.5 to 3 L/ha	 1 to 1.2 L/ac	• Apply Preharvest when approximately 50–75% of the bean pods have naturally changed colour from green to yellow or brown and at least 9 days before harvest. • **DO NOT** use on snap beans. • **DO NOT** apply to dry beans grown for seed. • Use the higher rate when the crop canopy is dense and/or there are high populations of weeds present at application. • Apply in a minimum of 110 L/ha (44 L/ac) of water at a pressure of 275 kPa (40 psi). Where crop canopy is dense, or weed growth is heavy, apply 170–220 L/ha (68–88 L/ac) of water. • **DO NOT** apply by air. • **DO NOT** apply if rain is expected within 4 hr. after application.
glyphosate * glyphosate (360 g/L) (* various formulations available)	0.9 kg/ha 2.5 L/ha	 1 L/ac	• Apply Preharvest when the crop is 30% grain moisture or less (yellow to brown pod colour, 80–90% leaf drop) and at least 7 days prior to harvest. • **DO NOT** use on snap beans. • **DO NOT** apply to crops grown for seed. • **DO NOT** apply by air. • Apply in 50–100 L/ha of water. • **DO NOT** apply if rain is expected within 6 hr. after application.
glyphosate/glufosinate ammonium ROUNDUP FASTFORWARD PREHARVEST ((18.75:1) 316 g/L)	0.948 kg/ha 3 L/ha	 1.2 L/ac	• Apply Preharvest when the crop is 30% grain moisture or less (yellow to brown pod colour, 80–90% leaf drop) and at least 7 days prior to harvest. • **DO NOT** use on snap beans. • **DO NOT** apply to crops grown for seed. • **DO NOT** apply by air. • Apply in 50–100 L/ha of water.

Notes:

Weed control ratings are given as 0–9 where 0 indicates no control and 9 indicates 90%–100% control under ideal conditions.

Ratings are subjective values based on best available information and give general comparisons based on use as descibed in this guide.

Crop tolerance ratings are E – Excellent, G – Good, F – Fair, P – Poor.

Under unfavorable conditions (eg., too dry, too wet, too cold, or poor application) the herbicides may not be as effective as indicated.

Ratings may vary with weed and crop stage and with the timing and rates of the product(s) being used.

Ratings in **BOLD** indicate the weed is listed on the product label for control or suppression.

Please see product label for more information on registered weed species, product uses and precautions.

TABLE 9. Beans (Dry, Lima And Snap) Herbicide Weed Control Ratings

Trade Name	Crop Registrations										Annual Grasses								Annual Broadleaves												Perennials							Crop Tolerance
	Adzuki Beans	Black Beans	Dutch Brown	Cranberry Beans	Kidney Beans	Lima Beans	Pinto Beans	Snap Beans	Yellow Eye	White Beans	barnyard grass	crabgrass	fall panicum	foxtail, giant	foxtail, green	foxtail, yellow	old witch grass	proso millet	buckwheat, wild	fleabane, Canada	lady's-thumb	lamb's-quarters	mustards	nightshades, annual	pigweeds	ragweed, common	ragweed, giant	velvetleaf	bindweed, field	horsetail	milkweed	nutsedge	quackgrass	sow-thistle	thistle, Canada	
soil applied grass herbicides																																				
DUAL MAGNUM					✓	✓	✓	✓		✓	**9**	**9**	**8/9[a]**	**8**	**9**	**9**	**9**	4	2	0	2	7	2	**8/9[c]**	**7/8**	4	3	2	0	0	0	**8/9[b]**	0	0	0	G
EPTAM		✓	✓	✓	✓		✓	✓	✓	✓	**9**	**9**	**9**	**9**	**9**	**9**	**9**	7	4	0	7	**7**	5	7	**7**	5	3	5	?	?	?	**8**	**5**	?	?	E
FRONTIER					✓					✓	**9**	**9**	**8/9[a]**	**8**	**9**	**9**	**9**	4	2	0	2	7	2	**8/9[c]**	**7/8**	4	3	2	0	0	0	**8/9[b]**	0	0	0	G
RIVAL, TREFLAN or BONANZA		✓			✓	✓		✓		✓	**9**	**9**	9	9	9	9	9	7	**5**	0	2	**8**	2	2	**8**	2	1	2	2	2	2	2	2	2	2	E
soil applied broadleaf herbicides																																				
AFESIN					✓	✓		✓	✓	✓	**5**	**5**	5	**5**	**5**	**5**	5	5	**8**	5	**9**	**9**	9	7	**9**	**8**	6	6	2	2	2	2	2	2	2	G
PATORAN	✓				✓	✓	✓	✓		✓	**5**	**5**	5	5	**5**	5	**5**	5	8	5	**9**	**9**	**9**	7	**9**	**8**	**6**	6	2	2	2	2	2	2	2	G
soil applied grass and broadleaf herbicides																																				
PURSUIT		✓	✓	✓	✓			✓	✓	✓	8	7	7	9	**9**	**9**	8	**7**	8	2	**9**	**9**	**9**	**9**	**9**	**8**	6	**9**	2	2	2	7	6	2	2	G
soil applied tank-mixes																																				
EPTAM + RIVAL, TREFLAN or BONANZA					✓					✓	**9**	**9**	**9**	**9**	**9**	**9**	**9**	7	5	5	7	**8**	5	8	**8**	5	3	5	?	?	?	**8**	**7**	?	?	E
PURSUIT + PATORAN					✓					✓	**8**	7	7	9	**9**	**9**	8	**7**	8	5	**9**	**9**	**9**	**9**	**9**	**8**	6	**9**	2	2	2	2	6	2	2	G

TABLE 9. Beans (Dry, Lima And Snap) Herbicide Weed Control Ratings

Trade Name	Crop Registrations										Annual Grasses								Annual Broadleaves										Perennials							Crop Tolerance
	Adzuki Beans	Black Beans	Dutch Brown	Cranberry Beans	Kidney Beans	Lima Beans	Pinto Beans	Snap Beans	Yellow Eye	White Beans	barnyard grass	crabgrass	fall panicum	foxtail, giant	foxtail, green	foxtail, yellow	old witch grass	proso millet	buckwheat, wild	fleabane, Canada	lady's-thumb	lamb's-quarters	mustards	nightshades, annual	pigweeds	ragweed, common	ragweed, giant	velvetleaf	bindweed, field	horsetail	milkweed	nutsedge	quackgrass	sow-thistle	thistle, Canada	
[redacted]																																			
ASSURE II								✓			9	8	9	9	9	8	9	9	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	E
EXCEL SUPER					✓		✓			✓	9	8	9	9	9	8	9	9	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	E
HOE-GRASS 284					✓	✓		✓		✓	8	5	8	8	9	8	8	3	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	E
POAST ULTRA[1]	✓	✓		✓	✓	✓	✓	✓[1]	✓	✓	9	8	9	9	9	9	9	9	0	0	0	0	0	0	0	0	0	0	0	0	0	6	0	0	E
SELECT		✓					✓				9	8	9	9	9	9	9	9	0	0	0	0	0	0	0	0	0	0	0	0	0	7	0	0	E
[redacted]																																			
BASAGRAN		✓	✓	✓	✓	✓	✓	✓	✓	✓	0	0	0	0	0	0	0	0	7	5	9	8	9	7	7	8	6	9	6	2	2	8	0	5	7	G
BASAGRAN FORTE					✓					✓	0	0	0	0	0	0	0	0	7	5	9	8	9	7	7	8	6	9	6	2	2	8	0	5	7	G
REFLEX		✓	✓	✓	✓	✓	✓	✓	✓	✓	0	0	0	0	0	0	0	0	8	2	8	6	9	8	9	9	7	6	?	?	?	?	?	?	?	F
[redacted]																																			
EXCEL SUPER + BASAGRAN					✓		✓			✓	9	8	9	9	9	8	9	9	7	5	9	8	9	7	7	8	6	9	5	2	2	8	1	5	7	G
BASAGRAN + REFLEX					✓					✓	0	0	0	0	0	0	0	0	8	5	9	8	9	8	9	9	7	9	5	2	2	8	1	5	7	F

* Various formulations available, see Table 1. See label for specific uses and rates.

? Insufficient information available to make a rating

[1] POAST ULTRA (quackgrass rate — 1.1 L/ha) is not registered for use on snap beans.

[a] Use the high rate of herbicide for optimum control

[b] Use PPI timing for optimum control

[c] Use PRE timing for optimum control

CHAPTER 8. CEREAL CROPS

Barley, Oats and Wheat (Spring), Not Underseeded to Forage Crops

Apply all treatments in 100–200 L/ha (40–80 L/ac) water except where otherwise noted.

Crop rotation is a valuable technique used to prevent the build up of weed populations associated with small grain production. Wild oats can increase in population and severely limit production on fields where small grains are grown continuously. Some weeds (e.g., proso millet) will be well controlled by cereal competition.

Blind harrowing with a light harrow, before emergence of cereals, can help to control small germinating weeds. A light harrow can also be used in cereals up to the 3–leaf stage, or a weeder harrow (L shaped flexible tines) at the 4–leaf stage to provide better control of small annual broadleaf weeds. The timing of these harrowing operations is critical. The weeds must be small and the soil surface must be dry and easily worked.

Weeds must be emerged from the soil surface and in early stages of growth to be killed by the rates of the herbicides used on cereal grains. Weeds which are growing during early periods of cereal growth (up to 5–leaf stage) have the greatest effect on the cereal yield.

Cereals are usually quite resistant to injury from 2,4-D, MCPA, 2,4-DB and MCPB. The growth stage for maximum safety varies with the cereal and the herbicide. Check the label for appropriate timing. When counting the leaves on cereal plants, some confusion can occur if tiller leaves are present. These leaves are not counted. The above diagram may be useful when determining the cereal leaf stages referred to in the publication.

Cereal grains have an advantage in that they do not make use of the full growing season. This is particularly true of the winter cereals where preplant cultivation and postharvest cultivation can be used to stimulate germination of weed seeds and reduce perennial weed populations.

Soil Applied Treatments include

- **Preplant (PP)** — Also see Chapter 6, **SPECIAL METHODS: Preplant — Site Preparation** for details of products, rates and remarks.
- **Preplant Incorporated (PPI)**
- **Preemergence (PRE)**

Postemergence (POST) — Leaf stage of the weeds is critical for good weed control. Smaller weeds are usually more sensitive to herbicide injury. Apply according to recommended leaf stages. Crop stage is important to optimize crop safety. Adjuvants will frequently improve the weed control when used as directed. Weather or other conditions may influence the optimum rate of adjuvant, see the product label for more details. Always use appropriate drift management technology.

Active Ingredient TRADE NAME (Formulation)	RATE (active) PRODUCT PER HA	RATE PRODUCT PER ACRE	PRECAUTIONS (For more information, see Chapter 4: Notes on Herbicides and Chapter 5: Notes on Adjuvants.)
Soil Applied Grass Herbicides			
triallate AVADEX BW (400g/L)	1.4 to 1.7 kg/ha 3.5 to 4.25 L/ha	1.4 to 1.7 L/ac	• To control wild oats in spring barley and spring wheat. • **Do NOT** use on tame oats. • For wheat, AVADEX BW must be applied after planting and worked into the soil to kill wild oats. • For barley, AVADEX BW can be applied before or after planting and must be worked into the soil. • Use the higher rate on heavier soils.

Active ingredient TRADE NAME Formulation	RATE (active) PRODUCT PER HA	RATE PRODUCT PER ACRE	PRECAUTIONS (For more information, see Chapter 4 Notes on Herbicides and Chapter 5 Notes on Adjuvants)
Postemergence Grass Herbicides			
diclofop-methyl HOE-GRASS 284 (284g/L)	0.71 to 0.795 kg/ha 2.5 to 2.8 L/ha	 1 to 1.12 L/ac	▪ Apply when the annual grasses are in the 1–5 leaf stage. ▪ HOE-GRASS must only be applied in the 1–4 leaf stage of barley and prior to tillering (usually not later than 21 days after emergence of the crop). Application beyond the 4–leaf stage or after tillering may result in barley damage. ▪ The higher rate (2.8 L/ha (1.12 L/ac)) must be used to control wild oats in the 4–5 leaf stage. ▪ **Do NOT** use on tame oats. ▪ PARDNER may be tank-mixed with HOE-GRASS for control of broadleaf weeds. ▪ If other herbicides are used for broadleaf weed control, they should be applied at least 4 days before or after HOE-GRASS.
difenzoquat AVENGE 200C (200g/L)	0.7 to 0.85 kg/ha 3.5 to 4.25 L/ha	 1.4 to 1.7 L/ac	▪ Apply when the wild oats are in the 3–5 leaf stage. ▪ **Do NOT** use on tame oats. ▪ Use the lower rate of AVENGE if the wild oat stand is less than 200 plants per m^2. ▪ **Do NOT** use when the plants are wet or if rain is expected within 6 hr.
tralkoxydim ACHIEVE 80DG (80 DG) plus TURBOCHARGE	0.2 kg/ha 0.25 kg/ha 0.5 L/100L	 0.1 kg/ac 0.5 L/100L	▪ Apply at 1–6 leaf stage of wild oats. ▪ **Do NOT** use on tame oats. ▪ Apply in 110 L/ha (44 L/ac) water. ▪ Herbicides not listed on the label may be applied separately 7 days after application of ACHIEVE 80DG. ▪ Wild oat control will be reduced if REFINE EXTRA is applied before ACHIEVE 80DG. ▪ **Do NOT** tank-mix REFINE EXTRA with ACHIEVE 80DG. ▪ Mature straw may be fed to livestock. One application per yr.
Postemergence Broadleaf Herbicides			
2,4-D * 2,4-D (470g/L)	0.35 to 0.85 kg/ha 0.75 to 1.8 L/ha	 0.3 to 0.7 L/ac	▪ Apply when the crop is in the 3–5 leaf stage of growth. On oats, do not apply more than 0.5 kg/ha (active) or 1.06 L/ha (0.42 L/ac) product (470 g/L).
2,4-D/ dicamba/ mecoprop KIL-MOR (485g/L)	0.413 to 0.534 kg/ha 0.85 to 1.1 L/ha	 0.34 to 0.44 L/ac	▪ For barley, use only the lower rate and apply when the crop is in the 2–3 leaf stage. ▪ For wheat apply when the crop is in the 3–4 leaf stage. ▪ Not registered for use on oats. ▪ The higher rate is required for control of Canada thistle and field bindweed.
2,4-DB CALIBER 400 (400g/L) COBUTOX 600 (600g/L) EMBUTOX 625 (625g/L)	1.1 to 1.4 kg/ha 2.75 to 3.5 L/ha 1.8 to 2.3 L/ha 1.75 to 2.25 L/ha	 1.1 to 1.4 L/ac 0.72 to 0.92 L/ac 0.7 to 0.9 L/ac	▪ Apply 2,4-DB at the 5–leaf to early flag stage of cereals.
bromoxynil PARDNER (280g/L) KORIL (235 g/L)	0.28 to 0.336 kg/ha 1 to 1.2 L/ha 1.2 to 1.4 L/ha	 0.4 to 0.48 L/ac 0.48 to 0.56 L/ac	▪ Apply when the weeds are in the 1–4 leaf stage and cereals are in the 2 to early flag leaf stage. Use the higher rate when weeds are past the 4 leaf stage. ▪ Best results are in the 2–5 leaf cereal stage since thorough coverage of weed foliage is required for optimum weed control.

bromoxynil PARDNER (280 g/L) KORIL (235 g/L) plus 2,4-D 2,4-D (470 g/L) or plus MCPA MCPA AMINE (500 g/L)	0.28 kg/ha 1 L/ha 1.2 L/ha 0.28 kg/ha 0.6 L/ha 0.28 to 0.55 kg/ha 0.55 to 1.1 L/ha	 0.4 L/ac 0.48 L/ac 0.24 L/ac 0.22 to 0.44 L/ac	▪ Apply to barley at the 4–5 leaf stage. ▪ Include 2,4-D or the lower rate of MCPA in mustards are present. ▪ Use the higher rate of MCPA if hempnettle is present. ▪ **Do NOT** use the 2,4-D mixture on oats.
bromoxynil/ MCPA BUCTRIL M ((1:1) 560 g/L) MEXTROL ((1:1) 400 g/L)	0.56 kg/ha 1 L/ha 1.4 L/ha	 0.4 L/ac 0.56 L/ac	▪ Apply when weeds are in the 1–4 leaf stage and cereals are in the 2 to early flag leaf stage. ▪ Wild buckwheat, common ragweed, mustards and lamb's–quarters are controlled up to the 8 leaf stage. ▪ Best results are obtained with applications at the 2–5 leaf cereal stage since thorough spray coverage of weed foliage is required for optimum weed control.
bromoxynil/ MCPA BUCTRIL M ((1:1) 560 g/L) plus thifensulfuron–methyl tribenuron–methyl REFINE EXTRA (75 DF) plus surfactant AGRAL 90, AGSURF, or CITOWETT PLUS	0.56 kg/ha 1 L/ha 5 g/ha 6.7 g/ha 2 L/1000 L	 0.4 L/ac 2.7 g/ac 2 L/1000 L	▪ **Do NOT** use on oats. ▪ Improved control of chickweed and hempnettle up to the 6 leaf stage with the addition of REFINE EXTRA.
clopyralid LONTREL 360 (360 g/L)	0.15 to 0.2 kg/ha 0.42 to 0.56 L/ha	 0.17 to 0.22 L/ac	▪ Apply when wheat or barley are at the 3–leaf to flag leaf emergence stages. ▪ Not registered for use on oats in Eastern Canada. ▪ For the control of Canada thistle and perennial sow-thistle (top growth only).
clopyralid LONTREL 360 (360 g/L) plus 2,4-D* 2,4-D (470 g/L) or plus MCPA MCPA AMINE (500 g/L)	0.1 to 0.25 kg/ha 0.28 to 0.69 L/ha 0.35 to 0.85 kg/ha 0.75 to 1.81 L/ha 0.35 to 0.85 kg/ha 0.7 to 1.7 L/ha	 0.11 to 0.28 L/ac 0.3 to 0.72 L/ac 0.28 to 0.68 L/ac	▪ LONTREL is not registered for use on oats in Eastern Canada. ▪ **Do NOT** use products containing 2,4-D on oats due to the probability of crop injury. ▪ In combination with 2,4-D or MCPA, the lower rate of LONTREL 360 will provide control of Canada thistle for 6–8 weeks and the higher rate of LONTREL 360 will provide season long control of Canada thistle.
dicamba BANVEL II (480 g/L)	0.11 to 0.139 kg/ha 0.23 to 0.29 L/ha	 0.09 to 0.12 L/ac	▪ Best performance when weeds are in the 2–3 leaf stage or rosettes less than 5 cm diameter. Use the higher rates on older weeds. ▪ Apply to wheat and barley when they are in the 2–5 leaf stage. ▪ Avoid spraying under conditions of fog or high humidity or when temperature is exceeding 30°C.
dicamba BANVEL II (480 g/L) plus 2,4-D* 2,4-D (470 g/L) or plus MCPA ESTEMINE MCPA (500 g/L)	0.11 to 0.14 kg/ha 0.23 to 0.29 L/ha 0.28 to 0.42 kg/ha 0.60 to 0.89 L/ha 0.28 to 0.42 kg/ha 0.55 to 0.85 L/ha	 0.09 to 0.12 L/ac 0.24 to 0.36 L/ac 0.22 to 0.34 L/ac	▪ The 2,4-D or MCPA should be included if mustards are present. ▪ Use only the lower rate on barley. ▪ Apply to wheat and barley when they are in the 2–5 leaf stage. ▪ **Do NOT** use BANVEL II + 2,4-D on oats.

Active Ingredient TRADE NAME (Formulation)	RATE (active) PRODUCT PER HA	RATE PRODUCT PER ACRE	PRECAUTIONS (For more information see Chapter 4 Notes on Herbicides and Chapter 5 Notes on Adjuvants
dicamba/ MCPA DYVEL ((1:4)420 g/L)	0.525 kg/ha 1.25 L/ha	 0.5 L/ac	• Apply when cereals are in the 2–5 leaf stage. • Hempnettle, corn spurry and cow cockle are controlled best when application is made early in this stage.
dicamba/ MCPA/ mecoprop TARGET (400 g/L) SWORD (400 g/L)	0.4 to 0.6 kg/ha 1 to 1.5 L/ha 1 to 1.5 L/ha	 0.4 to 0.6 L/ac 0.4 to 0.6 L/ac	• Use when wheat or oats are in the 2–5 leaf stage or barley in the 2–4 leaf stage. • Apply when weeds are in the 2–3 leaf stage. • Use the high rate if weeds are beyond the 3–leaf stage.
dicamba/ MCPA/ mecoprop TARGET (400 g/L) SWORD (400 g/L) plus linuron LOROX DF (50 DF) AFOLAN F (480 g/L) LINURON 480 (480 g/L)	0.4 to 0.6 kg/ha 1 to 1.5 L/ha 1 to 1.5 L/ha 0.205 kg/ha 0.41 kg/ha 0.43 L/ha 0.43 L/ha	 0.4 to 0.6 L/ac 0.4 to 0.6 L/ac 0.16 kg/ac 0.17 L/ac 0.17 L/ac	• Apply when the wheat or barley is in the 2–4 leaf stage. • **Do NOT** apply on oats. • May cause temporary yellowing of the lower leaves of wheat and barley.
dichlorprop/ 2,4-D ESTAPROP (582 g/L) DICHLORPROP D (582 g/L)	1.017 kg/ha 1.75 L/ha 1.75 L/ha	 0.7 L/ac 0.7 L/ac	• For spring wheat and barley only. • **Do NOT** apply on oats. • Apply to emerged weeds when the cereals are in the 4–leaf to early flag leaf stage.
linuron LOROX DF (50 DF) AFOLAN F (480 g/L) LINURON 480 (480 g/L) plus MCPA MCPA AMINE (500 g/L)	0.21 to 0.275 kg/ha 0.42 to 0.55 kg/ha 0.44 to 0.57 L/ha 0.44 to 0.57 L/ha 0.425 to 0.55 kg/ha 0.85 to 1.1 L/ha	 0.17 to 0.22 kg/ac 0.18 to 0.23 L/ac 0.18 to 0.23 L/ac 0.34 to 0.44 L/ac	• Apply when weeds are in the 1–4 leaf stage and cereals are in the 2–4 leaf stage. • May cause temporary yellowing of the lower leaves of the crop plants.
MCPA* MCPA AMINE (500 g/L)	0.35 to 0.85 kg/ha 0.7 to 1.7 L/ha	 0.28 to 0.68 L/ac	• Apply when the crop is in the 2–5 leaf stage of growth. • For hempnettle control, use the high rate of MCPA.
MCPB/MCPA TROPOTOX PLUS (400 g/L) CLOVITOX PLUS (400 g/L)	1.1 to 1.7 kg/ha 2.75 to 4.25 L/ha 2.75 to 4.25 L/ha	 1.1 to 1.7 L/ac 1.1 to 1.7 L/ac	• Apply MCPB/MCPA from the 2 leaf stage to flag leaf stage of cereals.
mecoprop MECOPROP (150 g/L) COMPITOX (150 g/L)	0.83 to 1.05 kg/ha 5.5 to 7 L/ha 5.5 to 7 L/ha	 2.2 to 2.8 L/ac 2.2 to 2.8 L/ac	• Use from the 3–leaf stage to early flag leaf when cereals are 10–15 cm tall. • Apply when weeds are in the 2–4 leaf stage. • Use the higher rate for more mature weeds.
thifensulfuron-methyl/ tribenuron-methyl REFINE EXTRA (75 DF) plus 2,4-D* 2,4-D (470 g/L) or plus MCPA ESTEMINE MCPA (500 g/L) plus surfactant AGRAL 90, AGSURF, or CITOWETT PLUS	15 g/ha 20 g/ha 0.42 to 0.55 kg/ha 0.89 to 1.17 L/ha 0.35 to 0.55 kg/ha 0.7 to 1.1 L/ha 2 L/1000L	 8 g/ac 0.35 to 0.47 L/ac 0.28 to 0.44 L/ac 2 L/1000L	• **Do NOT** apply 2,4-D tank-mix on oats. • Apply tank-mixes from the full 3–leaf stage to the 5–leaf stage of the crop. • Always add water soluble packages to clean water with agitator running. • **Do NOT** use on Leger Barley and Belvedere Wheat.

thifensulfuron–methyl/ tribenuron–methyl	15 g/ha		• Apply when the crop is in the 2–leaf to flag leaf (shot blade) stage. • Apply to emerged young actively growing weeds that are less than 10 cm tall or across. • Canada thistle, sow thistle and round–leaved mallow are suppressed. • Always add water soluble packages to clear water with agitator running. • **Do NOT** use on Leger Barley and Belvedere Wheat.
REFINE EXTRA (75 DF) plus surfactant	20 g/ha	8 g/ac	
AGRAL 90, AGSURF, or CITOWETT PLUS	2 L /1000 L	2 L /1000 L	
Postemergence Grass and Broadleaf Herbicides			
diclofop-methyl HOE-GRASS 284 (284 g/L) plus bromoxynil PARDNER (280g/L)	0.71 to 0.795 kg/ha 2.5 to 2.8 L/ha 0.28 kg/ha 1 L/ha	 1 to 1.12 L/ac 0.4 L/ac	• **Do NOT** spray on oats. • Apply when the annual grasses are in the 1–5 leaf stage, broadleaf weeds in the 1–4 leaf stage and when the cereals are in the 2–leaf to early flag leaf stage. • Best results are in the 2–5 leaf cereal stage since thorough coverage of weed foliage is required for optimum weed control. • The higher rate of HOE-GRASS must be used to control wild oats in the 4–5 leaf stage. HOE-GRASS must only be applied in the 1–4 leaf stage of barley and prior to tillering (usually no later then 21 days after emergence of the crop). Application beyond the 4–leaf stage or after tillering may result in barley damage. • Reduced grass control will occur if tank-mixed with other broadleaf herbicides. Broadleaf herbicide other than PARDNER must be sprayed 4 days after or before HOE-GRASS.
difenzoquat AVENGE 200C (200 g/L) plus 2,4-DB CALIBER 400 (400 g/L) COBUTOX 600 (600 g/L) EMBUTOX 625 (625 g/L)	0.7 to 0.85 kg/ha 3.5 to 4.25 L/ha 1.1 to 1.4 kg/ha 2.75 to 3.5 L/ha 1.8 to 2.3 L/ha 1.75 to 2.25 L/ha	 1.4 to 1.7 L/ac 1.1 to 1.4 L/ac 0.72 to 0.92 L/ac 0.7 to 0.9 L/ac	• Apply when the wild oats are in the 3–5 leaf stage and at the 5–leaf stage to early flag of cereals. • **Do NOT** spray on oats. • The lower rate of AVENGE should be used when wild oats density is less then 200 plants/m^2. • **Do NOT** use when the plants are wet or when the plants are wet or when rain is expected within 6 hr.
difenzoquat AVENGE 200C (200 g/L) plus bromoxynil PARDNER (280 g/L)	0.7 to 0.85 kg/ha 3.5 to 4.25 L/ha 0.28 to 0.336 kg/ha 1 to 1.12 L/ha	 1.4 to 1.7 L/ac 0.4 to 0.48 L/ac	• Apply when the wild oats are in the 3–5 leaf stage, broadleaf weeds in the 1–4 leaf stage and when the cereals are in the 2 to early flag leaf stage. • Best results are in the 2–5 leaf cereal stage since thorough coverage of weed foliage is required for optimum weed control. • **Do NOT** spray on oats. • The lower rate of AVENGE should be used when wild oats density is less then 200 plants/m^2. • **Do NOT** use when the plants are wet or when rain is expected within 6 hr.

Active ingredient TRADE NAME Formulation	RATE (active) PRODUCT PER HA	RATE PRODUCT PER ACRE	PRECAUTIONS (For more information see Chapter 4 Notes on Herbicides and Chapter 5 Notes on Adjuvants)
difenzoquat AVENGE 200C (200 g/L) plus bromoxynil/ MCPA BUCTRIL M ((1:1)560 g/L)	0.7 to 0.85 kg/ha 3.5 to 4.25 L/ha 0.56 kg/ha 1 L/ha	1.4 to 1.7 L/ac 0.4 L/ac	• Best results are in the 2–5 leaf cereal stage since thorough coverage of weed foliage is required for optimum weed control. • Apply when the wild oats are in the 3–5 leaf stage, broadleaf weeds in the 1–4 leaf stage and when the cereals are in the 2–leaf to early flag leaf stage. • Wild buckwheat, common ragweed, mustards and lamb's–quarters are controlled up to the 8 leaf stage. • **Do NOT** spray on oats. • The lower rate of AVENGE should be used when wild oats density is less then 200 plants/m^2. • **Do NOT** use when the plants are wet or when rain is expected within 6 hr.
difenzoquat AVENGE 200C (200 g/L) plus dichlorprop/ 2,4-D ESTAPROP (582 g/L)	0.7 to 0.85 kg/ha 3.5 to 4.25 L/ha 1.017 kg/ha 1.75 L/ha	1.4 to 1.7 L/ac 0.7 L/ac	• **Do NOT** spray on oats. • Apply when the wild oats are in the 3–5 leaf stage, broadleaf weeds in the 1–4 leaf stage and when the cereals are in the 4–leaf to early flag leaf stage. • Wild buckwheat, common ragweed, mustards and lamb's–quarters are controlled up to the 8 leaf stage. • Best results are in the 2–5 leaf cereal stage since thorough coverage of weed foliage is required for optimum weed control. • The lower rate of AVENGE should be used when wild oats density is less then 200 plants/m^2. • **Do NOT** use when the plants are wet or when rain is expected within 6 hr.
glyphosate * glyphosate (360 g/L)	1.71 to 4.32 kg/ha 4.75 to 12 L/ha	1.9 to 4.8 L/ac	• For spot treatment of perennials such as field bindweed (at full bloom stage) and Canada thistle, milkweed and common tansy (all in bud to full bloom stage) in standing crop. • Apply when the field bindweed has reached full bloom, Canada thistle, milkweed and common tansy are in the bud to full bloom stage. • Emerged cereals will be killed by this treatment. • To eliminate the possibility of residues in the crop, apply before the cereals have started to show heads.
propanil/ MCPA STAMPEDE CM ((3.6:1) 460 g/L)	1.267 kg/ha 2.75 L/ha	1.1 L/ac	• Apply when the cereals are in the 2–5 leaf stage and weeds are in the 1–4 leaf stage. • STAMPEDE CM may cause crop yellowing or leaf tip burn but these effects normally disappear in 10–14 days.
tralkoxydim ACHIEVE 80DG (80 DG) plus bromoxynil PARDNER (280 g/L)	0.2 kg/ha 0.25 kg/ha 0.28 to 0.336 kg/ha 1 to 1.12 L/ha	0.1 kg/ac 0.4 to 0.48 L/ac	• **Do NOT** spray on oats. • Apply when the wild oats are in the 1–6 leaf stage, broadleaf weeds in the 1–4 leaf stage and when the cereals are in the 2–leaf to early flag leaf stage. • Best results are in the 2–5 leaf cereal stage since thorough coverage of weed foliage is required for optimum weed control.

tralkoxydim ACHIEVE 80DG (80 DG) plus bromoxynil/ MCPA BUCTRIL M ((1:1)560 g/L)	0.2 kg/ha 0.25 kg/ha 0.56 kg/ha 1 L/ha	0.1 kg/ac 0.4 L/ac	▪ **Do NOT** spray on oats. ▪ Apply when the wild oats are in the 1–6 leaf stage, broadleaf weeds in the 1–4 leaf stage and when the cereals are in the 2 to early flag leaf stage. ▪ Wild buckwheat, common ragweed, mustards and lamb's–quarters are controlled up to the 8 leaf stage. ▪ Best results are in the 2–5 leaf cereal stage since thorough coverage of weed foliage is required for optimum weed control.
Preharvest			
glyphosate * glyphosate (360 g/L)	0.9 kg/ha 2.5 L/ha	1 L/ac	▪ Apply in 50–100 L/ha (20–40 L/ac) water when crop is at 30% grain moisture or less. ▪ Apply at least 7 days prior to harvest and use ground application only. ▪ **Do NOT** apply to seed crops. ▪ TOUCHDOWN and CREDIT are not registered for use on oats.
Postharvest Broadleaf Herbicides			
2,4-D/ dicamba/ mecoprop KIL-MOR (485 g/L)	0.534 to 0.85 kg/ha 1.1 to 1.75 L/ha	0.44 to 0.7 L/ac	▪ Apply to actively growing weed foliage. ▪ Wait at least 5 days after application before working the area.
dicamba BANVEL II (480 g/L)	1.202 kg/ha 2.5 L/ha	1 L/ac	▪ Apply to actively growing weed foliage at least 2 weeks before a killing frost. ▪ Wait at least 3 weeks after application before working the area. ▪ Plant only cereals, soybeans or field corn in the yr. after application.
Postharvest (Grass and Broadleaf Herbicides)			
amitrole AMITROL 240 (231g/L)	3 to 4 kg/ha 12.5 to 16.5 L/ha	5 to 6.6 L/ac	▪ Apply after harvest to emerged actively growing weeds 10–15 cm tall. ▪ Wait 2 weeks after spraying before working the area. **Do NOT** apply after heavy frost.
glyphosate * glyphosate (360 g/L)	0.9 kg/ha 2.5 L/ha	1 L/ac	▪ Use this treatment for a minimum of one season control of quackgrass. ▪ Apply in the fall in 50–100 L/ha (20–40 L/ac) water when the quackgrass is actively growing with at least 3–4 new leaves on each emerged shoots. ▪ Use flat fan nozzles. ▪ If higher water volumes are used, the addition of a surfactant such s ENHANCE, or LI700 is recommended.
glyphosate * glyphosate (360 g/L)	1.71 to 2.52 kg/ha 4.75 to 7 L/ha	1.9 to 2.8 L/ac	▪ For a minimum of 2 seasons control of quackgrass, use rates up to 7 L/ha (2.8 L/ac). ▪ Apply in the fall in 50–100 L/ha (20–40 L/ac) water when the quackgrass is actively growing with at least 3–4 new leaves on each emerged shoots. ▪ For Canada thistle, field bindweed and other perennial broadleaf weeds, apply to actively growing foliage. ▪ Wait at least 3 days after application before working the area. ▪ **For TOUCHDOWN wait at least 5 days after application before working the area.**

* Various formulations available, see Table 1. See label for specific uses and rates.

Active ingredient TRADE NAME Formulation	RATE (active) PRODUCT PER HA	RATE PRODUCT PER ACRE	PRECAUTIONS (For more information see Chapter 4 Notes on Herbicides and Chapter 5 Notes on Adjuvants)

Barley, Oats and Wheat (Spring), Underseeded to Forage Crops

Preplant (PP) – See Chapter 6, SPECIAL METHODS: **PREPLANT – SITE PREPARATION** for details of products, rates and remarks.

Postemergence Grass Herbicides

diclofop–methyl	0.71 to 0.795 kg/ha		• Apply when the annual grasses are in the 1–5 leaf stage.
HOE-GRASS 284 (284 g/L)	2.5 to 2.8 L/ha	1 to 1.12 L/ac	• The higher rate must be used to control wild oats in the 4–5 leaf stage. • HOE-GRASS must only be applied in the 1–4 leaf stage of barley and prior to tillering (usually no later then 21 days after emergence of the crop). • Application beyond the 4–leaf stage or after tillering may result in barley damage. • **Do NOT** spray on tame oats. • Use in cereals underseeded to alfalfa, and red or sweet clover. • Broadleaf herbicides must be sprayed 4 days after or before HOE-GRASS.
difenzoquat	0.7 to 0.85 kg/ha		• **Do NOT** spray on tame oats.
AVENGE 200C (200 g/L)	3.5 to 4.25 L/ha	1.4 to 1.7 L/ac	• Apply when the wild oats are in the 3–5 leaf stage. • Use the lower rate when the wild oat stand is less than 200 plants/m^2.
tralkoxydim	0.2 kg/ha		• **Do NOT** spray on tame oats.
ACHIEVE 80 DG	0.25 kg/ha	0.1 kg/ac	• For control of wild oats in cereals underseeded to alfalfa, clover and bird's foot trefoil.
plus mineral oil/surfactant			• Apply at 3–6 leaf stage of wild oats.
TURBOCHARGE	0.5 L/100 L	0.5 L/100 L	• Apply in 110 L/ha (44 L/ac) water. • Mature straw may be fed to livestock. • **Do NOT** feed or graze underseeded forage in yr. of treatment. • One application per yr.

Postemergence Broadleaf Herbicides

2,4-D *	0.28 to 0.42 kg/ha		• Use only if cereals are underseeded with grasses only.
2,4-D (470 g/L)	0.6 to 0.9 L/ha	0.24 to 0.36 L/ac	• Apply when the forage grasses have at least 2 leaves and cereals are in the 2–5 leaf stage.
2,4-DB	1.1 to 1.4 kg/ha		• Apply when the legumes are in the 1–4 trifoliate stage.
CALIBER 400 (400 g/L)	2.75 to 3.5 L/ha	1.1 to 1.4 L/ac	• Use only if cereals are underseeded to alfalfa, bird's foot trefoil, alsike or ladino clover and grasses.
COBUTOX 600 (600 g/L)	1.8 to 2.3 L/ha	0.72 to 0.92 L/ac	
EMBUTOX 625 (625 g/L)	1.75 to 2.25 L/ha	0.7 to 0.9 L/ac	• Apply in 150–200 L/ha (60–80 L/ac) water. • Wild mustard plants are not usually controlled if sprayed when they are beyond the 4–leaf stage. • Red clover will be damaged by 2,4-DB.
2,4-DB	0.8 kg/ha		• Apply when the legumes are in the 1–4 leaf stage.
CALIBER 400 (400 g/L)	2 L/ha	0.8 L/ac	• Use **only** if cereals are underseeded to alfalfa, bird's foot trefoil, alsike or ladino clover and grasses.
COBUTOX 600 (600 g/L)	1.3 L/ha	0.52 L/ac	
EMBUTOX 625 (625 g/L)	1.25 L/ha	0.5 L/ac	• The addition of MCPA gives better control of common mustard than 2,4-DB alone.
plus MCPA	35 g/ha		
ESTEMINE MCPA (500 g/L)	70 mL/ha	28 mL/ac	• Apply in 150–200 L/ha (60–80 L/ac) water.

MCPA ESTEMINE MCPA (500 g/L)	0.28 to 0.55 kg/ha 0.55 to 1.1 L/ha	0.22 to 0.44 L/ac	▪ Apply when the forage grasses have at least 2 leaves and cereals are in the 2–5 leaf stage. ▪ Use **only** if cereals are underseeded with grasses only.
MCPA MCPA SODIUM 300 (300 g/L)	0.3 to 0.45 kg/ha 1 to 1.5 L/ha	0.4 to 0.6 L/ac	▪ Use **only** if cereals are underseeded to red clover. ▪ Treat at an early stage of development of the clover when it is covered by a canopy of weeds and crop. ▪ Apply in 180–240 L/ha water (72–96 L/ac). ▪ The lower rate may not kill ragweed.
MCPB/MCPA (15:1) TROPOTOX PLUS (400 g/L) CLOVITOX PLUS (400 g/L)	1.1 to 1.7 kg/ha 2.75 to 4.25 L/ha 2.75 to 4.25 L/ha	 1.1 to 1.7 L/ac 1.1 to 1.7 L/ac	▪ Use **only** if cereals are underseeded to red, alsike, ladino or white dutch clover and grasses. ▪ Apply when legumes are in the unifoliate to the 4th trifoliate leaf stage. ▪ Apply in 150–200 L/ha (60–80 L/ac) water.
Postemergence Grass and Broadleaf Herbicides			
difenzoquat AVENGE 200C (200 g/L) plus 2,4-DB CALIBER 400 (400 g/L) COBUTOX 600 (600 g/L) EMBUTOX 625 (625 g/L)	0.7 to 0.85 kg/ha 3.5 to 4.25 L/ha 1.1 to 1.4 kg/ha 2.75 to 3.5 L/ha 1.8 to 2.3 L/ha 1.75 to 2.25 L/ha	 1.4 to 1.7 L/ac 1.1 to 1.4 L/ac 0.72 to 0.92 L/ac 0.7 to 0.9 L/ac	▪ Apply when the wild oats are in the 3–5 leaf stage and at the 5–leaf stage to early flag of cereals. ▪ **Do NOT** spray on tame oats. ▪ Use **only** if cereals are underseeded to alfalfa, bird's foot trefoil, alsike or ladino clover and grasses. ▪ Use this tank-mix to control wild oats and broadleaf weeds. ▪ The lower rate of AVENGE should be used when wild oats density is less then 200 plants/m^2. ▪ **Do NOT** use when the plants are wet or when the plants are wet or when rain is expected within 6 hr.
glyphosate * glyphosate (360 g/L)	1.71 to 4.32 kg/ha 4.75 to 12 L/ha	 1.9 to 4.8 L/ac	▪ For spot treatment of perennials such as field bindweed (at full bloom stage) and Canada thistle, milkweed and common tansy (all in bud to full bloom stage) in standing crop. ▪ Emerged crop plants will be killed by this treatment. ▪ **Do NOT** apply after the cereals have started to show heads. ▪ **Do NOT** harvest forage from the treated areas until the treated plants have turned brown. Apply at least 6 hr. before rain.
tralkoxydim ACHIEVE 80 DG (80 DG) plus 2,4-DB CALIBER 400 (400 g/L) COBUTOX 600 (600 g/L) EMBUTOX 625 (625 g/L) plus mineral oil/surfactant TURBOCHARGE	0.2 kg/ha 0.25 kg/ha 1.1 to 1.25 kg/ha 2.75 to 3.125 L/ha 1.8 to 2.1 L/ha 1.75 to 2 L/ha 0.5 L/100 L	 0.1 kg/ac 1.1 to 1.25 L/ac 0.72 to 0.84 L/ac 0.7 to 0.8 L/ac 0.5 L/100 L	▪ **Do NOT** apply prior to the 5–leaf stage of the cereal crop as temporary injury may occur. ▪ Use on cereals underseeded to alfalfa only. ▪ Use in a minimum of 125 L/ha water (50 L/ac). ▪ **Do NOT** use on tame oats. Avoid drift onto oats or corn crops. ▪ **Do NOT** use on other forages legumes or grasses.

* Various formulations available, see Table 1. See label for specific uses and rates.

Active Ingredient TRADE NAME (Formulation)	RATE (active) PRODUCT PER HA	RATE PRODUCT PER ACRE	PRECAUTIONS (For more information, see Chapter 4, Notes on Herbicides and Chapter 5, Notes on Adjuvants)
Wheat (Winter) and Fall Rye			
Apply all treatments in 100–200 L/ha (40–80 L/ac) water except where otherwise noted.			
Preplant (PP) — See Chapter 6, **SPECIAL METHODS: PREPLANT — SITE PREPARATION** for details of products, rates and remarks.			
Soil Applied Grass Herbicides			
trifluralin	0.383 to 0.546 kg/ha		• For loose silky bentgrass control in the fall.
BONANZA 400 (400 g/L)	0.96 to 1.37 L/ha	0.38 to 0.55 L/ac	• Apply as soon as possible after planting.
TREFLAN (480 g/L)	0.8 to 1.14 L/ha	0.32 to 0.46 L/ac	• Incorporate shallowly into the soil surface with drag harrows.
RIVAL DF (60 DF)	0.64 to 0.91 kg/ha	0.26 to 0.36 kg/ac	• Seed the crop approx. 5 cm deep to separate the germinating seed from the chemical.
Postemergence Grass Herbicides			
diclofop-methyl	0.71 to 0.795 kg/ha		• Apply when the annual grasses are in the 1–5 leaf stage.
HOE-GRASS 284 (284 g/L)	2.5 to 2.8 L/ha	1 to 1.12 L/ac	• HOE-GRASS must only be applied in the 1–4 leaf stage of barley and prior to tillering (usually no later then 21 days after emergence of the crop). • Application beyond the 4–leaf stage or after tillering may result in barley damage. • The higher rate must be used to control wild oats in the 4–5 leaf stage. • Use in cereals underseeded to alfalfa, and red or sweet clover. • Broadleaf herbicides must be sprayed 4 days after or before HOE-GRASS.
diclofop-methyl	1 kg/ha		• Apply in the fall to loose silky bentgrass at the 1–4 leaf stage in winter wheat or fall rye.
HOE-GRASS 284 (284 g/L)	3.5 L/ha	1.4 L/ac	
tralkoxydim	0.2 kg/ha	0.1 kg/ac	• For the control of wild oats, apply when at the 1–6 leaf stage.
ACHIEVE 80 DG (80 DG)	0.25 kg/ha	0.5 L/100 L	• **Do NOT** use on rye.
plus mineral oil/surfactant	0.5 L/100 L		• Apply in 110 L/ha water (44 L/ac).
TURBOCHARGE			• Herbicides not listed on the label may be applied separately 7 days after application of ACHIEVE 80DG. • Wild oat control will be reduced if REFINE EXTRA is applied before ACHIEVE 80 DG. • **Do NOT** tank-mix REFINE EXTRA with ACHIEVE 80 DG. • Mature straw may be fed to livestock. • One application per yr.
Postemergence Broadleaf Herbicides			
2,4-D *	0.35 to 0.55 kg/ha		• Treat in the spring when the crop growth begins until the early shotblade stage.
2,4-D (470 g/L)	0.75 to 1.17 L/ha	0.3 to 0.47 L/ac	• For control of winter annuals apply early before flower buds appear on the weeds.
2,4-D/ dicamba/ mecoprop	0.413 to 0.534 kg/ha		• Apply in early spring when winter annual weeds are in the rosette stage.
KIL-MOR (485 g/L)	0.85 to 1.1 L/ha	0.34 to 0.44 L/ac	• Apply before the crop is more than 30 cm high (top leaf extended). • **Do NOT use on rye.**
bromoxynil	0.28 to 0.336 kg/ha		• Winter wheat may be treated from the 2–4 leaf stage in the fall or from the time growth begins to early flag leaf stage in the spring.
PARDNER (280 g/L)	1 to 1.2 L/ha	0.4 to 0.48 L/ac	
KORIL (235 g/L)	1.2 to 1.4 L/ha	0.48 to 0.56 L/ac	• More effective on winter annuals when applied as a fall treatment.

bromoxynil/ MCPA BUCTRIL M ((1:1) 560 g/L) MEXTROL ((1:1) 400 g/L)	0.56 kg/ha 1 L/ha 1.4 L/ha	 0.4 L/ac 0.56 L/ac	• Winter wheat may be treated from the 2–4 leaf stage in the fall or from the 2–leaf to early leaf flag stage in the spring.
bromoxynil/ MCPA BUCTRIL M ((1:1) 560 g/L) plus thifensulfuron-methyl/ tribenuron-methyl REFINE EXTRA (75 DF) plus surfactant AGRAL 90, AGSURF, or CITOWETT PLUS	0.56 kg/ha 1 L/ha 5 g/ha 6.7 g/ha 2 L/1000 L	 0.4 L/ac 2.7 g/ac 2 L/1000 L	• Improved control of chickweed and hempnettle up to the 6–leaf stage with the addition of REFINE EXTRA. • Control of chickweed may be reduced if the plants are past the 6–leaf stage and flowering at time of application.
dicamba BANVEL II (480 g/L)	0.11 to 0.139 kg/ha 0.23 to 0.29 L/ha	 0.09 to 0.12 L/ac	• Apply in the spring when the crop is 15–25 cm tall before the shotblade stage. • Can be used with 2,4-D or MCPA amine 0.42 kg/ha (0.84 L/ha (0.33 L/ac) of 500 g/L formulations). • The addition of 2,4-D or MCPA will give improved control of pepper-grass, shepherd's purse and pennycress. • **Do NOT use on fall rye.**
dicamba/ MCPA DYVEL ((1:4) 420 g/L)	0.505 kg/ha 1.2 L/ha	 0.48 L/ac	• Apply to winter wheat in the spring when weeds have emerged and the crop is 15–25 cm tall before the shotblade stage. • **Do NOT use on rye.**
dicamba/ MCPA/ mecoprop TARGET (400 g/L) SWORD (400 g/L)	0.4 to 0.6 kg/ha 1 to 1.5 L/ha 1 to 1.5 L/ha	 0.4 to 0.6 L/ac 0.4 to 0.6 L/ac	• Apply in spring before the crop is more than 30 cm high (top leaf extended). • Winter annuals should be sprayed as soon as new growth starts. • Apply when other weeds are in the 2–3 leaf stage. • **Do NOT use on rye.**
dichlorprop/ 2,4-D ESTAPROP (582 g/L) DICHLORPROP D (582 g/L)	1.017 kg/ha 1.75 L/ha 1.75 L/ha	 0.7 L/ac 0.7 L/ac	• Apply in early spring to emerged weeds. • May be used until cereals are up to the flag leaf stage.
MCPA MCPA AMINE (500 g/L)	0.35 to 0.85 kg/ha 0.7 to 1.7 L/ha	 0.28 to 0.68 L/ac	• Treat in the spring when the crop growth begins until the early shotblade stage. • For control of winter annuals apply early before flower buds appear on the weeds.
mecoprop MECOPROP (150 g/L) COMPITOX (150 g/L)	0.83 to 1.05 kg/ha 5.5 to 7 L/ha 5.5 to 7 L/ha	 2.2 to 2.8 L/ac 2.2 to 2.8 L/ac	• Use from the 3–leaf stage to early flag leaf when cereals are 10–15 cm tall. • Apply when weeds are in the 2–4 leaf stage. • Use the higher rate for more mature weeds.
thifensulfuron- methyl tribenuron methyl REFINE EXTRA (75 DF) plus 2,4-D 2,4-D (470 g/L) or MCPA ESTEMINE MCPA (500 g/L) plus surfactant AGRAL 90, AGSURF, or CITOWETT PLUS	15 g/ha 20 g/ha 0.42 to 0.55 kg/ha 0.89 to 1.17 L/ha 0.35 to 0.55 kg/ha 0.7 to 1.1 L/ha 2 L/1000 L	 8 g/ac 0.36 to 0.47 L/ac 0.28 to 0.44 L/ac 2 L/1000 L	• Apply tank-mixes from the full 3–leaf stage to the 5–leaf stage of the crop. • Always add water soluble packages to clean water with agitator running. • **Do NOT use on rye.**

Active ingredient TRADE NAME (Formulation)	RATE (active) PRODUCT PER HA	RATE PRODUCT PER ACRE	PRECAUTIONS (For more information see Chapter 4 Notes on Herbicides and Chapter 5 Notes on Adjuvants)
thifensulfuron- methyl/ tribenuron methyl REFINE EXTRA (75 DF) plus surfactant AGRAL 90, AGSURF, or CITOWETT PLUS	15 g/ha 20 g/ha 2 L/1000 L	 8 g/ac 2 L/1000 L	▪ Apply to emerged young actively growing weeds that are less than 10 cm tall or across. ▪ Canada thistle, sow thistle and round-leaved mallow are suppressed. ▪ Apply when the crop is in the 2–leaf to flag leaf (shot blade) stage. ▪ Always add water soluble packages to clear water with agitator running. ▪ **Do NOT use on rye.**
Postemergence Grass and Broadleaf Herbicides			
diclofop-methyl HOE-GRASS 284 (284 g/L) plus bromoxynil PARDNER (280 g/L)	0.71 to 0.795 kg/ha 2.5 to 2.8 L/ha 0.28 to 0.336 kg/ha 1 to 1.2 L/ha	 1 to 1.12 L/ac 0.4 to 0.48 L/ac	▪ For spring treatment from the time winter wheat growth begins until early flag leaf. ▪ Apply when the annual grasses are in the 1–5 leaf stage, broadleaf weeds in the 1–4 leaf stage. ▪ The higher rate of HOE-GRASS must be used to control wild oats in the 4–5 leaf stage. ▪ Broadleaf herbicide other than PARDNER must be sprayed 4 days after or before HOE-GRASS.
tralkoxydim ACHIEVE 80DG (80 DG) plus bromoxynil PARDNER (280 g/L)	0.2 kg/ha 0.25 kg/ha 0.28 to 0.336 kg/ha 1 to 1.2 L/ha	 0.1 kg/ac 0.4 to 0.48 L/ac	▪ Use this tank-mix to control wild oats and broadleaf weeds. ▪ Apply when the wild oats are in the 1–6 leaf stage and when the winter wheat is in the 2–4 leaf stage in the fall and in the 2 to early flag leaf stage in the spring. ▪ More effective on winter annuals when applied in the fall.
tralkoxydim ACHIEVE 80DG (80 DG) plus bromoxynil/ MCPA BUCTRIL M ((1:1) 560 g/L)	0.2 kg/ha 0.25 kg/ha 0.56 kg/ha 1 L/ha	 0.1 kg/ac 0.4 L/ac	▪ Use this tank-mix to control wild oats and broadleaf weeds. ▪ Apply when the wild oats are in the 1–6 leaf stage and when the winter wheat is in the 2–4 leaf stage in the fall and in the 2 to early flag leaf stage in the spring.
Preharvest			
glyphosate* glyphosate (360 g/L)	0.9 kg/ha 2.5 L/ha	 1 L/ac	▪ Use on wheat only. ▪ Apply in 50–100 L/ha (20–40 L/ac) water when the crop is at 30% grain moisture or less (consult label for visual indicators). ▪ Apply at least 7 days prior to harvest and use ground application only. ▪ **Do NOT** apply to seed crops.

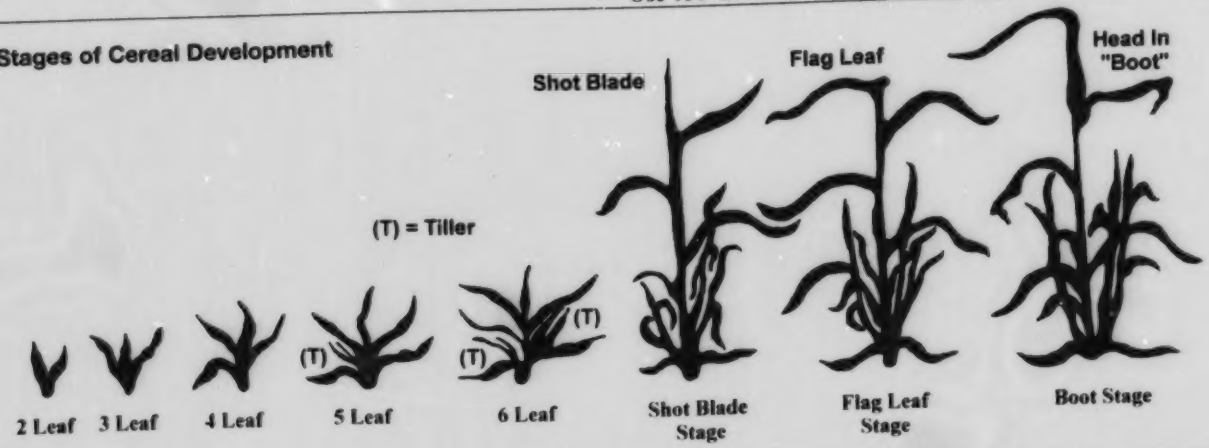
* Various formulations available, see Table 1. See label for specific uses and rates.

Wheat (Winter) and Fall Rye Underseeded To Clovers

Apply all treatments in 100–200 L/ha (40–80 L/ac) water except where otherwise noted.

Preplant (PP) — See Chapter 6, **SPECIAL METHODS: PREPLANT – SITE PREPARATION** for details of products, rates and remarks.

Postemergence Grass Herbicides			
tralkoxydim ACHIEVE 80DG (80 DG) plus mineral oil/surfactant TURBOCHARGE	0.2 kg/ha 0.25 kg/ha 0.5 L/100 L	0.1 kg/ac 0.5 L/100 L	▪ For the control of wild oats, apply when at the 1–6 leaf stage. ▪ **Do NOT** use on rye. ▪ Apply in 110 L/ha water (44 L/ac). ▪ Mature straw may be fed to livestock. ▪ **Do NOT** feed or graze underseeded forage in year of treatment. ▪ One application per yr.
Postemergence Broadleaf Herbicides			
bromoxynil/ MCPA BUCTRIL M ((1:1) 560 g/L)	0.56 kg/ha 1 L/ha	0.4 L/ac	▪ Apply in the spring when the red clover is in the 1st–3rd trifoliate stage and when the winter wheat provides a protective canopy over the clover. ▪ **Do NOT** use on rye. ▪ Apply in not less than 200 L/ha water (80 L/ac). ▪ **Do NOT** apply if clover is under stress, and avoid overlaps as injury to the red clover may result.
MCPA MCPA SODIUM 300 (300 g/L)	0.3 to 0.45 kg/ha 1 to 1.5 L/ha	0.4 to 0.6 L/ac	▪ Apply in the spring when crop growth commences until early shotblade stage. ▪ Treat when the legumes are in an early stage of development and covered by a canopy of weeds and crop. ▪ Apply in 180–240 L/ha water (72–96 L/ac).
MCPB/MCPA TROPOTOX PLUS (400 g/L) CLOVITOX PLUS (400 g/L)	1.1 to 1.7 kg/ha 2.75 to 4.25 L/ha 2.75 to 4.25 L/ha	1.1 to 1.7 L/ac 1.1 to 1.7 L/ac	▪ Apply in the spring when the cereal crop is in the 2 leaf to flag leaf stage, and the weeds are small and actively growing. ▪ Legumes should be in the 1–3 trifoliate stage. ▪ Use 150–200 L/ha water (60–80 L/ac).



Notes:

Weed control ratings are given as 0–9 where 0 indicates no control and 9 indicates 90%–100% control under ideal conditions.

Ratings are subjective values based on best available information and give general comparisons based on use as descibed in this guide.

Under unfavorable conditions (eg., too dry, too wet, too cold, or poor application) the herbicides may not be as effective as indicated.

Ratings may vary with weed and crop stage and with the timing and rates of the product(s) being used.

Ratings in **BOLD** indicate the weed is listed on the product label for control or suppression.

Please see product label for more information on registered weed species, product uses and precautions.

TABLE 10. Cereal Herbicide Weed Control Ratings

Trade Name	Crop						Annual Grasses								Annual Broadleaves																Perennial Weeds										
	oats	spring barley	spring wheat	winter barley	fall rye	fall wheat	barnyard grass	crabgrass	fall panicum	foxtail, giant	foxtail, green	foxtail, yellow	old witch grass	proso millet	wild oats	buckwheat, wild	cocklebur	chickweed, common	corn spurry	fleabane, Canada	hempnettle	lady's thumb	lamb's-quarters	mustards	nightshades	pigweeds	ragweed, common	ragweed, giant	shepherd's purse	stinkweed	velvetleaf	bindweed, field	chickweed, mouse-eared	curled dock	dandelion	ground-ivy (creeping-charlie)	horsetail	mallow	milkweed	nutsedge	plantains	quackgrass	sow-thistle	thistle, Canada	vetches
[redacted]																																										
AVADEX BW		✓	✓				?	?	?	?	?	?	?	?	**8**	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TREFLAN				✓	✓	✓	**9**	**9**	9	9	**9**	**9**	9	7	**8**	**5**	2	**?**	?	0	5	2	**8**	2	2	**8**	2	1	?	?	2	2	**?**	0	0	?	2	?	2	2	?	2	2	2	?
[redacted]																																										
ACHIEVE 80DG		✓	✓			✓	**2**	?	?	?	**9**	**9**	?	?	**9**	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AVENGE 200C		✓	✓				?	?	?	?	?	?	?	?	**9**	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HOE-GRASS 284		✓	✓			✓	**8**	?	?	8	**8**	**8**	?	?	9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
[redacted]																																										
2,4-D*	✓	✓	✓		✓	✓	0	0	0	0	0	0	0	0	0	**7**	**8**	**7**	2	?	2	**7**	**9**	**9**	7	**9**	**9**	?	**9**	**9**	**8**	**7**	**?**	**7**	**8**	?	2	4	6	**0**	**8**	0	5	**8**	0
2,4-DB*	✓	✓	✓	✓		✓	0	0	0	0	0	0	0	0	0	6	9	2	2	?	2	7	**9**	**9**	7	**9**	**9**	?	8	**6**	8	?	2	6	5	?	2	2	0	0	8	0	5	?	2
BANVEL II	✓	✓	✓			✓	0	0	0	0	0	0	0	0	0	**9**	9	8	**9**	8	7	**9**	9	7	9	9	9	?	6	6	9	8	?	9	8	?	0	?	0	0	?	0	**9**	**8**	5
BUCTRIL M, MEXTROL	✓	✓	✓	✓	✓	✓	0	0	0	0	0	0	0	0	0	**9**	**8**	?	2	?	7	**9**	**9**	**9**	**9**	**8**	**9**	?	**9**	**9**	**9**	7	?	?	?	?	7	?	0	0	?	0	**7**	**7**	?
DYVEL	✓	✓	✓	✓		✓	0	0	0	0	0	0	0	0	0	**9**	**?**	?	**9**	8	**8**	**9**	**9**	**9**	?	**9**	**9**	?	**9**	**9**	?	8	?	?	?	?	?	?	?	?	0	**8**	**8**	?
ESTAPROP, DICHLORPROP-D, DIPHENOPROP		✓	✓	✓		✓	0	0	0	0	0	0	0	0	0	**8**	**?**	?	2	8	7	**8**	**9**	**9**	?	**9**	**9**	?	**9**	**9**	?	7	?	?	?	?	2	**?**	?	?	?	0	8	**8**	?
KIL-MOR	✓	✓	✓	✓		✓	0	0	0	0	0	0	0	0	0	**9**	**8**	?	**9**	8	?	**9**	**9**	**9**	**8**	**9**	**9**	?	?	?	**8**	**8**	?	?	?	?	2	?	0	0	?	0	**8**	**8**	?
LONTREL		✓	✓				0	0	0	0	0	0	0	0	0	**8**	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	**9**	?	?	?	?	?	?	?	**9**	**9**	**9**
LOROX + MCPA*	✓	✓	✓				?	?	?	?	?	?	?	?	?	**0**	9	**8**	**9**	5	**9**	**9**	**9**	9	?	**9**	**9**	6	?	**?**	?	?	8	?	?	?	?	?	?	?	?	?	?	?	?	?
MCPA*	✓	✓	✓	✓	✓	✓	0	0	0	0	0	0	0	0	0	2	**7**	**?**	**7**	?	**8**	**2**	**9**	**9**	?	**9**	**9**	?	**9**	**9**	**8**	7	?	?	?	?	8	?	0	0	**?**	0	7	7	5
MECOPROP, COMPITOX	✓	✓	✓	✓		✓	0	0	0	0	0	0	0	0	0	2	?	**9**	**9**	?	2	2	**9**	**9**	?	9	9	?	?	7	?	?	9	?	?	?	?	?	?	?	**?**	0	?	**7**	5
PARDNER, KORIL	✓	✓	✓	✓	✓	✓	0	0	0	0	0	0	0	0	0	**8**	**8**	2	2	?	2	**8**	**9**	**7**	**9**	**7**	**9**	?	**8**	**8**	**9**	5	?	?	?	?	0	?	0	0	?	0	6	5	?
REFINE EXTRA	✓	✓	✓	✓		✓	0	0	0	1	0	0	0	0	0	**9**	?	**?**	**9**	?	**9**	9	**9**	**8**	?	**9**	2	?	**9**	**9**	?	2	?	?	?	?	?	?	**?**	?	?	?	0	**8**	**8**	?

TABLE 10. Cereal Herbicide Weed Control Ratings

Trade Name	Crop						Annual Grasses									Annual Broadleaves																				Perennial Weeds													
	oats	spring barley	spring wheat	winter barley	fall rye	fall wheat	barnyard grass	crabgrass	fall panicum	foxtail, giant	foxtail, green	foxtail, yellow	old witch grass	proso millet	wild oats	buckwheat, wild	cocklebur	chickweed, common	corn spurry	fleabane, Canada	hempnettle	lady's thumb	lamb's-quarters	mustards	nightshades	pigweeds	ragweed, common	ragweed, giant	shepherd's purse	stinkweed	velvetleaf	bindweed, field	chickweed, mouse-eared	curled dock	dandelion	ground-ivy (creeping-charlie)	horsestail	mallow	milkweed	nutsedge	plantains	quackgrass	sow-thistle	thistle, Canada	vetches
STAMPEDE CM	✓	✓	✓				?	?	?	?	8	8	?	?	2	8	?	7	?	?	?	8	9	9	?	9	9	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?
SWORD, TARGET	✓	✓	✓	✓		✓	0	0	0	0	0	0	0	0	0	9	?	?	9	8	8	8	9	9	?	9	9	?	9	9	?	8	?	?	?	?	?	?	?	?	?	0	8	8	?
TROPOTOX PLUS, CLOVITOX PLUS	✓	✓	✓	✓	✓	✓	0	0	0	0	0	0	0	0	0	7	?	2	2	?	8	2	9	9	?	9	8	?	9	9	9	8	?	?	?	?	?	?	?	0	?	0	9	9	5
[redacted]																																															
ACHIEVE + BUCTRIL M		✓	✓				2	?	?	?	9	9	?	?	9	9	8	?	2	?	7	9	9	9	9	8	9	?	9	9	9	7	?	?	?	?	7	?	0	0	?	0	7	7	?
ACHIEVE + PARDNER		✓	✓				2	?	?	?	9	9	?	?	9	8	8	2	2	?	2	8	9	7	9	7	9	?	8	8	9	5	?	?	?	?	0	?	0	0	?	0	6	5	?
AVENGE + 2,4-BD*		✓	✓				?	?	?	?	?	?	?	?	9	6	9	2	2	?	2	7	9	9	7	9	9	?	8	6	8	?	2	6	5	?	2	2	0	0	8	0	5	?	2
AVENGE + BUCTRIL M		✓	✓				?	?	?	?	?	?	?	?	9	9	8	?	2	?	7	9	9	9	9	8	9	?	9	9	9	7	?	?	?	?	7	?	0	0	?	0	7	7	?
AVENGE + ESTAPROP		✓	✓				?	?	?	?	?	?	?	?	9	8	?	?	2	8	7	8	9	9	?	9	9	?	9	9	?	7	?	?	?	?	2	?	?	?	?	0	8	8	?
BANVEL II + 2,4-D* or MCPA*	✓	✓	✓			✓	0	0	0	0	0	0	0	0	0	9	9	7	9	8	7	9	9	9	9	9	9	?	9	9	8	8	?	9	8	?	0	?	0	0	8	0	9	8	5
BUCTRIL M, MEXTROL + 2,4-D* or MCPA*	✓	✓	✓		✓	✓	0	0	0	0	0	0	0	0	0	9	8	7	2	?	7	9	9	9	9	9	9	?	9	9	9	7	?	7	8	?	7	4	6	0	8	0	7	8	?
HOE-GRASS + PARDNER		✓	✓				8	?	?	8	8	8	?	?	9	8	8	2	2	?	2	8	9	7	9	7	9	?	8	8	9	5	?	?	?	?	0	?	0	0	?	0	6	5	?
LONTREL + 2,4-D* or MCPA*		✓	✓				0	0	0	0	0	0	0	0	0	8	8	7	2	?	2	7	9	9	7	9	9	?	9	9	8	7	?	7	8	?	2	4	6	?	8	?	9	9	9
PARDNER, KORIL + 2,4-D* or MCPA*	✓	✓	✓		✓	✓	0	0	0	0	0	0	0	0	0	8	8	7	2	?	2	8	9	9	9	9	9	?	9	9	9	7	?	7	8	?	2	4	6	0	8	0	6	8	0
REFINE EXTRA + 2,4-D OR MCPA	✓	✓	✓			✓	0	0	0	0	0	0	0	0	0	9	8	7	9	?	9	9	9	9	7	9	9	?	9	9	8	7	?	7	8	?	2	4	6	?	8	0	8	8	?
TARGET + LOROX, AFOLAN OR LINURON 480	✓	✓	✓			✓	0	0	0	0	0	0	0	0	0	9	9	8	9	8	8	8	9	9	?	9	9	6	9	9	8	8	8	?	?	?	8	?	?	?	?	0	8	8	?

* Various formulations available, see Table 1. See label for specific uses and rates.

** Indicates annual weeds will be controlled if emerged. Glyphosate can be used only before planting, as a spot treatment or after harvest. Roundup can also be used preharvest.

✓ Can be used on this crop.

[1] More complete control can be obtained with treatment of actively growing foliage after harvest.

?Insufficient information available to make a rating

CHAPTER 9. CORN, FIELD AND SWEET

Critical Stage: The Critical Stage to control weeds in corn is the 2–8 leaf over stage (3–10 leaf tips).

All treatments should be applied in 150–300 L/ha (60–120 L/ac) water unless otherwise specified.

Any single method of weed control or the continuous use of the same chemicals can lead to the build up of weeds resistant or tolerant to that control method. Triazine-resistant lamb's-quarters and pigweed have become a problem as a result of continuous corn and the repeated use of triazine herbicides. Rotation to other crops and/or other control methods will reduce the chance of new or unique weed infestations.

Blind harrowing with a set of light harrows operating at a shallow depth before the corn has emerged, or using a weeder harrow (with L shaped flexible tines) when the crop is 5–10 cm high can also help control small annual weed seedlings. High speed (10 kph), shallow (2.5–3 cm) cultivation with the rotary hoe when corn is 7–8 cm in height will help to control small weed seedlings. These techniques will not reduce herbicide action and may in some years enhance chemical weed control. Inter-row cultivation can be used to complement other weed control measures. Row cultivation is most effective when weeds are small. Cultivation should be shallow to reduce the germination of new weed seeds, to reduce moisture loss and to reduce corn root injury. Inter-row cultivation may be required when weeds escape herbicide treatment; weeds should be considered as escapes when they are 5–7 cm high.

Band treatment of chemical over the row will reduce cost by one-half to two-thirds, depending on the row spacing and width of band. Shallow inter-row cultivation will be required to control weeds between the bands.

Cultivation will give some control of established perennial weeds but may also help to spread them to previously uninfested areas. Machinery sanitation is important when moving from one field to another. Many perennials (i.e. nutsedge) can be spread on tillage equipment. Custom operators should be particularly careful when moving from one farm to another

Sweet corn most frequently is grown in areas where the crops in sequence are very sensitive to atrazine residues. Avoid using atrazine rates above 1.1 kg/ha (active) (2.3 L/ha (0.92 L/ac) of 480 g/L) or 1.2 kg/ha (0.48 kg/ac) of (90 WG) product. (See notes on atrazine residues for suggestions).

Seed Corn Recommendations: Some field corn recommendations are applicable to seed corn, however, there are inbreds, which are susceptible to some chemicals. Check with the contracting company before applying any herbicide. For information on specific weeds see the *Corn (Field and Sweet) Herbicide Weed Control Ratings Table* and then refer to the appropriate section for details about herbicide treatment.

Nitrogen solution can be used as a carrier, instead of water, for preplant and preemergence application of some herbicides. Weed control activity is not increased. Spraying should be done before crop emergence. Consult the herbicide label as to the proper methods of application and use of dispersing agents. Calibrate the sprayer to apply the required amount of nitrogen. Stainless steel flood jet nozzles of adequate size (e.g. Teejet TK SS 5 to TK SS 10) should be used. The nitrogen solution is mildly corrosive, especially to brass, and the sprayer should be cleaned immediately after use. UNITE may be used as an aid in improving liquid fertilizer herbicide compatibility and stability when a simultaneous application of a liquid fertilizer and liquid or wettable powder herbicide is desired. Because formulations and rates vary, it is essential to read the label to determine the exact amount and method to be used.

Do NOT apply nitrogen solution with postemergence herbicides.

SPECIAL NOTES FOR CORN, FIELD AND SWEET

Postemergence applications with 2,4-D, MCPA, MCPB, 2,4-DB, DICAMBA and KIL-MOR: 2,4-D, 2,4-DB, MCPA, dicamba, KIL-MOR and some mixtures are needed for control of such weeds as thistles, field bindweed, and triazine-resistant weeds.

Postemergence treatment with 2,4-D can be combined with cultural practices for the control of a wide range of weeds. After the crop is sown, use the rotary hoe, finger weeder, or light harrows to control weed seedlings until the corn is about 5–15 cm high (leaf extended). Then apply an overall spray of 2,4-D.

Some varieties of corn become increasingly susceptible to damage from 2,4-D beyond the 15 cm height (leaf extended) but if many broadleaf weeds are present in the rows, spraying is still recommended provided that drop pipes are used on the sprayer to direct the spray to the base of each corn plant, thus missing the corn leaves.

Do NOT cultivate until at least 2 weeks after 2,4-D spray treatment, and then only if necessary. Corn is often brittle for a period of time after spraying and may be damaged by equipment. Cultivation may also damage the shallow feeding roots of corn, as well as bringing ungerminated weed seeds to the ground surface. Following a period of drought, avoid 2,4-D application for at least a week after a good rain or irrigation.

The recommended 2,4-D treatments will control the top growth and reduce the competition of the more common broadleaved perennial weeds.2,4-DB and mixtures of MCPB and MCPA (15:1) can be used on corn at higher rates than 2,4-D and therefore will give better control of Canada thistle, sow-thistle, field bindweed and wild buckwheat. These materials should be applied when the corn is 30–60 cm high, using drop pipes. Spot treatment is often possible. Dicamba, dicamba + 2,4-D tank-mix or KIL-MOR provide good control of such difficult weeds as field bindweed and Canada thistle. Drop pipes should be used when Canada thistle is in the bud stage and field bindweed is at the early flowering stage. PRECAUTIONS: **Do NOT** use 2,4-D, MCPA, MCPB, 2,4-DB, dicamba, or KIL-MOR later than 2 weeks prior to the first appearance of tassels or ear silk. Extreme care must be used when applying these

herbicides near susceptible crops because of possible herbicide movement. Soybeans, tomatoes and tobacco are extremely sensitive to dicamba and KIL-MOR and injury symptoms may persist for several weeks. **Do not** use dicamba in the area of susceptible crops when temperatures exceed 25°C on the day of application or if high humidity is expected, due to the possibility of dicamba volatilizing and injuring susceptible crops nearby. Several rows of corn should be left unsprayed when adjacent to soybean fields or other susceptible crops (use precautions on back cover).

Triazine-Resistant Annual Weeds: Strains of lamb's-quarters, pigweed, ragweed and old witch grass have been found that are resistant to high rates of all TRIAZINE herbicides including atrazine, cyanazine and simazine. These triazine-resistant species have been found in corn growing areas across Ontario. These strains cannot be visibly distinguished from the susceptible strains. Preemergence treatment with dicamba or linuron or postemergence treatment with bentazon, bromoxynil, 2,4-D, dicamba, KIL-MOR or directed linuron will usually give control of the broadleaf species (see appropriate sections above). The grasses can be controlled with EPTC+, or metolachlor (see sections above).

Notes on Atrazine and Simazine Soil Residues: Atrazine and simazine residues may last for more than one year, particularly if high rates are used more than once and dry weather occurs. If atrazine or simazine is used year after year as in a continuous corn program, triazine residues may be higher. Atrazine when used at rates from 1.2–1.5 kg/ha (active) (2.4–3.0 L/ha (0.96–1.2 L/ac) of (500 g/L) or 1.2–1.7 kg/ha (0.48–0.68 kg/ac) of (90 WG) PRODUCT) on corn generally has not caused injury on succeeding crops of oats, barley, mixed grains, or soybeans, except in years where there was very little rain the previous fall which would slow down atrazine degradation in the soil. Postemergence treatments may persist longer than preemergence treatments. Variations from this generality of 1.2–1.5 kg/ha atrazine may occur across the province.

Injury has been reported on tomatoes, white beans, forage seedlings, peas, tobacco, cucumbers, onions, and turnips following applications of atrazine at more than 1.1 kg/ha (active) (2.3 L/ha (0.96 L/ac) of (480 g/L) or 1.2 kg/ha (0.48 kg/ac) of (90 WG) PRODUCT) on corn the previous year.

To reduce the hazard of atrazine residues on succeeding crops:

1. Apply the early postemergence atrazine oil-water treatment with the lower rate of atrazine: 1.1. kg/ha (active) (2.2 L/ha (0.88 L/ac) of (500 gL) or 1.2 kg/ha (0.48 kg/ac) of (90 WG) PRODUCT). With this lower rate, a lower measure of weed control may result and cultivation may be necessary.
2. Fall plowing will reduce TRIAZINE injury more than will spring plowing.
3. Moldboard plowing will disperse herbicide residue to a greater soil depth than chisel plowing, thus reducing the concentration of herbicide in the upper soil area.
4. Ensure that the sprayer used is adequate and is properly calibrated and adjusted. Spray uniformly without overlaps and do not spray while the sprayer is stopped.

If a residue problem is anticipated, contact your local crop consultant or dealer for information on soil analysis procedures for triazine residues.

Soil Applied Treatments include

- **Preplant (PP)** – Also see Chapter 6, **SPECIAL METHODS: Preplant — Site Preparation** for details of products, rates and remarks.
- **Preplant Incorporated (PPI)** — Two incorporations at right angles operating at a depth of 10 cm using a double disk (7–10 km/hr) or vibrating shank S-tine cultivator (10–13 km/hr) are required unless otherwise stated. Cultivation-type equipment used for herbicide incorporation is known to spread perennial weeds to previously uninfested areas. Special attention should be directed toward machinery cleanliness, and/or treating fields with perennial weeds last.
- **Preemergence (PRE)** — Rainfall of 15–20 mm within 10 days after application is necessary to activate preemergence treatments. Shallow cultivation, rotary hoeing or harrowing will control weed escapes and improve herbicide activity in the absence of rainfall.

Postemergence (POST) — Leaf stage of the weeds is critical for good weed control. Smaller weeds are usually more sensitive to herbicide injury. Apply according to recommended leaf stages. Crop stage is important to optimize crop safety. Adjuvants will frequently improve the weed control when used as directed. Weather or other conditions may influence the optimum rate of adjuvant, see the product label for more details. Always use appropriate drift management technology.

Active ingredient TRADE NAME Formulation	RATE (active) PRODUCT PER HA	RATE PRODUCT PER ACRE	PRECAUTIONS For more information, see Chapter 4 Notes on Herbicides and Chapter 5 Notes on Adjuvants
Burndown and Residual Control			
Refer to the "conservation tillage section" for information on treatments specific for use in conservation till, minimum-till or no-till systems.			
atrazine	1.53 kg/ha		• Apply at least 3 days prior to crop emergence. • Some perennial species may escape (alfalfa, bromegrass and orchard grass). • Consideration should be given to follow up treatments when the corn is at the approximate stage of growth with herbicide treatments recommended for use in the conventional tillage corn section. • Apply in 325–500 L/ha water 130–200 L/ac).
AATREX NINE-O (90 WG)	1.7 kg/ha	0.68 kg/ac	
AATREX (480 g/L)	3.18 L/ha	1.27 L/ac	
ATRAZINE 480 (480 g/L)	3.18 L/ha	1.27 L/ac	
plus paraquat	0.55 to 1.1 kg/ha		
GRAMOXONE (200 g/L)	2.75 to 5.5 L/ha	1.1 to 2.2 L/ac	
dimethenamid	1 to 1.25 kg/ha		• Use the higher rate of FRONTIER for heavier weed populations. • Follow with sequential postemergence herbicide for additional broadleaf weed control.
FRONTIER (900 g/L)	1.1 to 1.4 L/ha	0.44 to 0.56 L/ac	
plus glyphosate	0.89 kg/ha		
ROUNDUP (356 g/L)	2.5 L/ha	1 L/ac	
or plus glyphosate TMS	0.825 kg/ha		
TOUCHDOWN 480 (330 g/L)	2.5 L/ha	1 L/ac	
dimethenamid	1 to 1.25 kg/ha		• Use the higher rate of FRONTIER for heavier weed populations. • Control of non-emerged triazine resistant weeds will be limited to pigweed.
FRONTIER (900 g/L)	1.1 to 1.4 L/ha	0.44 to 0.56 L/ac	
plus atrazine	1 to 1.53 kg/ha		
AATREX NINE-O (90 WG)	1.11 to 1.7 kg/ha	0.44 to 0.68 kg/ac	
plus glyphosate	0.89 kg/ha		
ROUNDUP (356 g/L)	2.5 L/ha	1 L/ac	
dimethenamid	1 to 1.25 kg/ha		• Use the higher rate of FRONTIER for heavier weed populations.
FRONTIER (900 g/L)	1.1 to 1.4 L/ha	0.44 to 0.56 L/ac	
plus dicamba	0.6 kg/ha		
BANVEL II (480 g/L)	1.25 L/ha	0.5 L/ac	
plus glyphosate	0.89 kg/ha		
ROUNDUP (356 g/L)	2.5 L/ha	1 L/ac	
dimethenamid	1 to 1.25 kg/ha		• Use the higher rate of FRONTIER for heavier weed populations.
FRONTIER (900 g/L)	1.1 to 1.4 L/ha	0.44 to 0.56 L/ac	
plus dicamba/ atrazine	1.8 kg/ha		
MARKSMAN ((1:2)401 g/L)	4.5 L/ha	1.8 L/ac	
plus glyphosate	0.89 kg/ha		
ROUNDUP (356 g/L)	2.5 L/ha	1 L/ac	
flumetsulam/clopyralid	185 g/ha		• May be applied PPI or PRE up to 15 days before planting. When incorporated set equipment to uniformly work soil at a depth of 5–8.5 cm. Sufficient rainfall to moisten the soil to a depth of 5 cm is necessary to move FIELDSTAR into the weed germination zone. • **Do NOT** use on soils with pH > 7.8 or < 5.9. • **Do NOT** use on soils with less than 2% organic matter. • **Do NOT** apply to corn treated with a granular organophosphate insecticide. • **Do NOT use on seed corn, popcorn or sweet corn.**
FIELDSTAR ((1:2.7) 85.6 WG)	216 g/ha	86 g/ac	
plus glyphosate TMS	0.825 g/L		
TOUCHDOWN 480 (330 g/L)	2.5 L/ha	1 L/ac	

linuron AFOLAN F (480 g/L) plus glyphosate TMS TOUCHDOWN 480 (330 g/L)	1.8 to 2.26 kg/ha 3.75 to 4.7 L/ha 0.825 kg/ha 2.5 L/ha	 1.5 to 1.88 L/ac 1 L/ac	• Apply PRE. • Plant corn at least 4 cm deep. Heavy rainfall and adverse weather conditions may result in temporary crop injury. • Annual grasses, ragweed and velvetleaf are partially controlled but are the first to escape, particularly if low rates of the herbicide are used. • Can be used on selected sweet corn varieties. • **Do NOT** use on sandy soils.
pendimethalin PROWL plus glyphosate TMS TOUCHDOWN 480 (330 g/L)	1.68 kg/ha 4.2 L/ha 0.825 kg/ha 2.5 L/ha	 1.68 L/ac 1 L/ac	• Plant corn at least 4 cm deep and ensure good seed coverage. • If rain is not received within 7 days, rotary hoeing or shallow cultivation is required. • **Do NOT use on seed corn or sweet corn.**
s-metolachlor/benoxacor DUAL II MAGNUM (915 g/L) plus glyphosate ROUNDUP (360 g/L) GLYPHOS (360 g/L) or plus glyphosate TMS TOUCHDOWN 480 (330 g/L)	1.14 to 1.6 kg/ha 1.25 to 1.75 L/ha 0.84 to 0.89 kg/ha 2.35 to 2.5 L/ha 2.35 to 2.5 L/ha 0.825 kg/ha 2.5 L/ha	 0.5 to 0.7 L/ac 0.94 to 1 L/ac 0.94 to 1 L/ac 1 L/ac	• Use the higher rate of DUAL II MAGNUM for heavier weed populations. • Use higher rate of glyphosate when perennial weeds are present. • Apply in 200 L/ha water (80 L/ac).

s-metolachlor/benoxacor
DUAL II MAGNUM (915 g/L)
plus atrazine
AATREX NINE-O (90 WG)
	1.14 to 1.6 kg/ha
	1.25 to 1.75 L/ha
	1 to 1.53 kg/ha
	1.11 to 1.7 kg/ha
		
		0.5 to 0.7 L/ac
		
		0.44 to 0.68 kg/ac
			• Apply pre-plant burndown application only when emerged weeds are less than 6 cm tall. If emerged annual weeds are taller than 6 cm apply glyphosate prior to the tank-mix application or make an application of 3–way tank-mix of DUAL II MAGNUM plus atrazine plus glyphosate.
			• For improved burndown of small emerged annual weeds, the following additives may be applied:
			  ▪ Crop oil, 28-0-0 or 10-34-0 at 50 L/1000 L;
			  ▪ Crop oil concentrate at 10 L/1000 L;
			  ▪ Non-ionic surfactant at 1 L/1000 L.
			• Use higher rates for heavier weed populations.

s-metolachlor/benoxacor DUAL II MAGNUM (915 g/L) plus atrazine AATREX LIQUID 480 (480 g/L) or s-metolachlor/benoxacor/atrazine PRIMEXTRA II MAGNUM ((1:0.8)720 g/L) plus glyphosate ROUNDUP (360 g/L) GLYPHOS (360 g/L) or glyphosate TMS TOUCHDOWN 480 (330 g/L)	1.14 to 1.6 kg/ha 1.25 to 1.75 L/ha 2.1 to 3.1 L/ha 2.16 to 2.88 kg/ha 3 to 4 L/ha 0.836 to 0.89 kg/ha 2.35 to 2.5 L/ha 2.35 to 2.5 L/ha 0.825 kg/ha 2.5 L/ha	 0.5 to 0.7 L/ac 0.85 to 1.5 kg/ac 1.2 to 1.6 L/ac 0.94 to 1 L/ac 0.94 to 1 L/ac 1 L/ac	• Use the higher rate of DUAL II MAGNUM for heavier weed populations. • Use higher rate of glyphosate when perennial weeds are present. • Many broadleaf perennial weeds may not be controlled at this time and rate of application. • For tank-mixtures of PRIMEXTRA II MAGNUM plus any of the glyphosate products, to ensure optimum compatibility: 'Add PRIMEXTRA II MAGNUM to the tank first, then add AGRAL 90, AGSURF, COMPANION, ENHANCE, OR FRIGATE at 5 L/1000 L. Continue agitation and add the glyphosate mix partner.' • Apply in 200 L/ha (80 L/ac) water.

Active Ingredient TRADE NAME (Formulation)	RATE (active) PRODUCT PER HA	RATE PRODUCT PER ACRE	PRECAUTIONS (For more information see Chapter 4 Notes on Herbicides and Chapter 5 Notes on Adjuvants)
Soil Applied Grass Herbicides			
dimethenamid FRONTIER (900 g/L)	1 to 1.25 kg/ha 1.1 to 1.4 L/ha	 0.44 to 0.56 L/ac	• Apply PPI or PRE. Incorporation equipment should be set to work soil no deeper than 10 cm. • Control of yellow nutsedge is obtained when FRONTIER is applied PPI. Minimum PPI rate is 1.125 kg/ha. • Use the higher rate of FRONTIER for the control of nightshade and pigweed. • **Do NOT** use on muck, peat, or high organic matter soils. • See tank-mixes for treatments to provide annual broadleaf control or follow with sequential postemergence broadleaf herbicide. • **Do NOT use on seed corn or popcorn.**
dimethenamid FRONTIER (900 g/L)	1 to 1.125 kg/ha 1.1 to 1.25 L/ha	 0.44 to 0.5 L/ac	• For pre-emergence use on seed corn. • Use the lower rate on soils of lower organic matter and the higher rate on medium and fine textured soils. • Consult the seed supplier for information on the tolerance of seed corn inbred lines prior to the use of FRONTIER herbicide.
EPTC/ R25788 (EPTC+) ERADICANE (800 g/L)	3.4 to 4.4 kg/ha 4.25 to 5.5 L/ha	 1.7 to 2.2 L/ac	• Must be PPI. • **Do NOT use on seed corn.**
flufenacet/ metribuzin AXIOM (68 DF)	0.57 to 1 kg/ha 0.84 to 1.47 kg/ha	 0.34 to 0.59 kg/ac	• Apply PRE. • **Do NOT** apply to coarse textured soils with less than 2% OM. • **Do NOT use on seed corn or sweet corn.**
s-metolachlor/benoxacor DUAL II MAGNUM (915 g/L)	1.14 to 1.6 kg/ha 1.25 to 1.75 L/ha	 0.5 to 0.7 L/ac	• Apply PPI or PRE. Incorporation equipment should be set to work soil no deeper than 10 cm. • Control of yellow nutsedge is obtained when DUAL II MAGNUM is applied PPI. • Optimal control of nightshade is obtained when DUAL II MAGNUM is applied PRE. • **Do NOT** use on muck, peat, or high organic matter soils. • See tank-mixes for treatments to provide annual broadleaf control or follow with sequential postemergence broadleaf herbicide.
Soil Applied Broadleaf Herbicides			
atrazine ATRAZINE 480 (480 g/L) AATREX NINE-O (90 WG)	1.01 to 1.49 kg/ha 2.1 to 3.1 L/ha 1.12 to 1.65 kg/ha	 0.84 to 1.24 L/ac 0.45 to 0.66 kg/ac	• Apply PRE. • Weeds will normally emerge and die within a few days; atrazine can persist for varying lengths of time; longer under dry, cool weather and coarse textured soils. See tank-mixes for reducing rates and avoiding residues, and for treatments to provide annual grass control.

atrazine ATRAZINE 480 (480 g/L) AATREX NINE-O (90 WG) plus dicamba BANVEL II (480 g/L) or dicamba/atrazine MARKSMAN ((1:2) 401 g/L)	1.01 to 1.49 kg/ha 2.1 to 3.1 L/ha 1.12 to 1.65 kg/ha 0.6 kg/ha 1.25 L/ha 1.8 kg/ha 4.5 L/ha	 0.84 to 1.24 L/ac 0.45 to 0.66 kg/ac 0.5 L/ac 1.8 L/ac	• Apply PRE. • This treatment should provide good control of triazine resistant broadleaf weeds and velvetleaf. • See notes on atrazine with respect to residues. • See precautions for BANVEL II applied alone. • **Do NOT apply to sand or sandy loam soils.** • **Do NOT use on seed corn or sweet corn.**.
dicamba BANVEL II (480 g/L)	0.6 kg/ha 1.25 L/ha	 0.5 L/ac	• Apply PRE to corn seed planted 4 cm or more deep before weeds and corn emerge. If corn seed is less than 4 cm below the soil surface, delay application of BANVEL II until the spike stage of corn. • Apply to medium to fine textured soils containing more than 2.5% organic matter. • **Do NOT** use on sandy or sandy loam soils. • **Do NOT** incorporate.
flumetsulam/clopyralid FIELDSTAR ((1:2.7) 85.6 WG)	185 g/ha 216 g/ha	 86 g/ac	• May be applied PPI or PRE up to 15 days before planting. When incorporated set equipment to uniformly work soil at a depth of 5–8.5 cm. Sufficient rainfall to moisten the soil to a depth of 5 cm is necessary to move FIELDSTAR into the weed germination zone. • **Do NOT** use on soils with pH > 7.8 or < 5.9. • **Do NOT** use on soils with less than 2% organic matter. • **Do NOT** apply to corn treated with a granular organophosphate insecticide. • **Do NOT use on seed corn, popcorn or sweet corn.**
simazine PRINCEP NINE to T (90 WG) or simazine SIMADEX (500 g/L) SIMAZINE 480 (480 g/L)	1.35 to 2.25 kg/ha 1.5 to 2.5 kg/ha 1.6 to 4 kg/ha 3.2 to 8 L/ha 3.4 to 8.3 L/ha	 0.6 to 1 kg/ac 1.28 to 3.2 L/ac 1.36 to 3.32 L/ac	• Apply PRE. • These products are listed separately because of their widely differing rate ranges. In both cases the low rates should be used on sandy soils while the higher rates may be used on loams and clays. • Full season annual weed control can be expected except for crabgrass or fall panicum where infestations have built up. • Caution is advised that when considering rates beyond 2.0 kg/ha (0.8 kg/ac) as soil residues may be high.
Soil Applied Grass and Broadleaf Herbicides			
cyanazine BLADEX 90 DF (90 DF)	2.25 to 2.7 kg/ha 2.5 to 3 kg/ha	 1 to 1.2 kg/ac	• Apply PRE. • Barnyard grass and redroot pigweed may escape. Use the low rate on coarse textured soils and on sweet corn. • BLADEX is not recommended alone for fine textured or muck soils. • See other treatments for appropriate tank-mixes.

Active Ingredient TRADE NAME (Formulation)	RATE (active) PRODUCT PER HA	RATE PRODUCT PER ACRE	PRECAUTIONS (For more information, see Chapter 4 Notes on Herbicides and Chapter 5 Notes on Adjuvants)
cyanazine BLADEX 90 DF (90 DF) BLADEX LIQUID (480 g/L) plus atrazine ATRAZINE 480 (480 g/L) AATREX NINE-O (90 WG)	2.11 to 2.64 kg/ha 2.35 to 3 kg/ha 4.4 to 5.5 L/ha 1.128 to 1.3 kg/ha 2.35 to 2.7 L/ha 1.25 to 1.44 kg/ha	 0.94 to 1.2 kg/ac 1.76 to 2.2 L/ac 0.94 to 1.08 L/ac 0.5 to 0.58 kg/ac	• Apply PPI at these rates. • This combination will improve barnyard grass and pigweed control over cyanazine alone. • Use the lower rate of both BLADEX and atrazine on coarse textured soils and the higher rates on medium to fine textured soils. • **Do NOT** use on muck or peat soils. • Mid season (July) germinating fall panicum may not be controlled.
cyanazine BLADEX 90 DF (90 DF) plus atrazine ATRAZINE 480 (480 g/L) AATREX NINE-O (90 WG)	1.8 to 2.25 kg/ha 2 to 2.5 kg/ha 1.2 to 1.49 kg/ha 2.5 to 3.1 L/ha 1.35 to 1.65 kg/ha	 0.8 to 1 kg/ac 1 to 1.24 L/ac 0.54 to 0.66 kg/ac	• Apply PRE. • The tank-mix of BLADEX plus atrazine will improve control on fine textured soils and control of barnyard grass and redroot pigweed. • **Do NOT** use the mixture on muck or peat soils. • Fall panicum or velvetleaf may not be controlled for the full season.
cyanazine BLADEX LIQUID (480 g/L) BLADEX 90 DF (90 DF) plus atrazine AATREX (480 g/L) AATREX NINE-O (90 WG) ATRAZINE 480 (480 g/L) plus dicamba BANVEL II (480 g/L)	2.25 kg/ha 4.75 L/ha 2.5 kg/ha 1.082 kg/ha 2.25 L/ha 1.2 kg/ha 2.25 L/ha 0.6 kg/ha 1.25 L/ha	 1.9 L/ac 1 kg/ac 0.9 L/ac 0.48 kg/ac 0.9 L/ac 0.5 L/ac	• Apply PRE. • Treatment provides effective control of annual broadleaf and grass weeds including triazine resistant broadleaves. The addition of atrazine will improve control on fine textured soils and control of barnyard grass and redroot pigweed. • **Do NOT** use on sand or sandy loam soils. • **Do NOT use on seed corn or sweet corn.**
cyanazine BLADEX LIQUID (480 g/L) BLADEX 90 DF (90 DF) plus dicamba BANVEL II (480 g/L)	2.25 to 2.7 kg/ha 4.75 to 5.5 L/ha 2.5 to 3 kg/ha 0.6 kg/ha 1.25 L/ha	 1.9 to 2.2 L/ac 1 to 1.2 kg/ac 0.5 L/ac	• Apply PRE. • Barnyard grass may not be adequately controlled. Use higher rates on fine soils and heavy weed infestations. • BLADEX and BANVEL are short lived and will disappear before the end of the season. BANVEL controls velvetleaf, and triazine (atrazine, cyanazine or simazine) resistant broadleaf weeds. See precautions for BLADEX and BANVEL alone. • **Do NOT incorporate this tank-mix or use on sand or sandy loam soils.** • **Do NOT use on seed corn or sweet corn.**
dimethenamid FRONTIER (900 g/L) plus atrazine AATREX NINE-O (90 WG)	1 to 1.25 kg/ha 1.1 to 1.4 L/ha 1 to 1.53 kg/ha 1.11 to 1.7 kg/ha	 0.44 to 0.56 L/ac 0.44 to 0.68 kg/ac	• Apply PREPLANT. • Use the higher rate of FRONTIER for heavier weed populations. Control of non-emerged triazine resistant weeds will be limited to pigweed. • For improved burndown control the addition of glyphosate may be required.

dimethenamid	1 to 1.25 kg/ha		▪ Apply PPI or PRE.
FRONTIER (900 g/L)	1.1 to 1.4 L/ha	0.44 to 0.56 L/ac	▪ The minimum rate of FRONTIER for the PPI application is 1.25 L/ha (0.5 L/ac). Triazine resistant pigweed will be suppressed.
plus atrazine	1.5 kg/ha		
ATRAZINE 480 (480 g/L)	3.12 L/ha	1.25 L/ac	▪ **Do NOT use on seed corn, popcorn or sweet corn.**
AATREX NINE-O (90 WG)	1.67 kg/ha	0.67 kg/ac	
or plus cyanazine	2.7 kg/ha		
BLADEX LIQUID (480 g/L)	5.5 L/ha	2.2 L/ac	
BLADEX 90 DF (90 DF)	3 kg/ha	1.2 kg/ac	
dimethenamid	1 to 1.25 kg/ha		▪ Apply PREPLANT.
FRONTIER (900 g/L)	1.1 to 1.4 L/ha	0.44 to 0.56 L/ac	▪ Use the higher rate of FRONTIER for heavier weed populations. For improved burndown control the addition of glyphosate may be required.
plus dicamba	0.6 kg/ha		
BANVEL II (480 g/L)	1.25 L/ha	0.5 L/ac	▪ See precautions for BANVEL II applied alone.
dimethenamid	1 to 1.25 kg/ha		▪ Apply PRE.
FRONTIER (900 g/L)	1.1 to 1.4 L/ha	0.44 to 0.56 L/ac	▪ See precautions for BANVEL II applied alone.
plus dicamba	0.6 kg/ha		▪ **Do NOT** use these tank-mixes on sandy soils.
BANVEL II (480 g/L)	1.25 L/ha	0.5 L/ac	▪ **Do NOT use on seed corn, popcorn or sweet corn.**
or plus dicamba/ atrazine	1.8 kg/ha		
MARKSMAN ((1:2) 401 g/L)	4.5 L/ha	1.8 L/ac	
dimethenamid	1 to 1.25 kg/ha		▪ Apply PREPLANT.
FRONTIER (900 g/L)	1.1 to 1.4 L/ha	0.44 to 0.56 L/ac	▪ Use the higher rate of FRONTIER for heavier weed populations. For improved burndown control the addition of glyphosate may be required.
plus dicamba/ atrazine	1.8 kg/ha		
MARKSMAN ((1:2) 401 g/L)	4.5 L/ha	1.8 L/ac	▪ See precautions for BANVEL II applied alone.
EPTC/ R25788 (EPTC+)	3.4 to 6.8 kg/ha		▪ Apply PPI.
ERADICANE (800 g/L)	4.25 to 8.5 L/ha	1.7 to 3.4 L/ac	▪ For suppression of moderate to heavy infestations of wild proso millet, use the higher rate of ERADICANE with atrazine. For most effective suppression of proso millet delay treatment and planting until mid to late May. Cultivation or a directed post application of linuron may be required to control later emerging proso millet.
plus atrazine	1.2 to 1.49 kg/ha		
ATRAZINE 480 (480 g/L)	2.5 to 3.1 L/ha	1 to 1.24 L/ac	
AATREX NINE-O (90 WG)	1.35 to 1.65 kg/ha	0.54 to 0.66 kg/ac	▪ **Do NOT use on seed corn.**
EPTC/ R25788 (EPTC+)	6.8 kg/ha		▪ Apply PPI.
ERADICANE (800 g/L)	8.5 L/ha	3.4 L/ac	▪ For increased control of proso millet, an inter to row cultivation should be used.
plus cyanazine	2 to 2.25 kg/ha		▪ **Do NOT use on seed corn.**
BLADEX LIQUID (480 g/L)	4.25 to 4.7 L/ha	1.7 to 1.9 L/ac	
BLADEX 90 DF (90 DF)	2.25 to 2.5 kg/ha	0.9 to 1 kg/ac	
EPTC/ R25788 (EPTC+)	1.7 to 3.4 kg/ha		▪ Apply PPI.
ERADICANE (800 g/L)	2.13 to 4.25 L/ha	0.85 to 1.7 L/ac	▪ Note that this is a reduced rate of SENCOR. This tank-mix provides improved velvetleaf control but will not control proso millet, triazine resistant weeds or cocklebur.
plus metribuzin	0.3 kg/ha		
SENCOR 500 F (500 g/L)	0.6 L/ha	0.24 L/ac	▪ **Do NOT use on seed corn or sweet corn.**
SENCOR 75 DF (75 WG)	0.4 kg/ha	0.16 kg/ac	
EVICT SOLUPAK (75 WG)	0.4 kg/ha	0.16 kg/ac	

Active Ingredient TRADE NAME (Formulation)	RATE (active) PRODUCT PER HA	RATE PRODUCT PER ACRE	PRECAUTIONS (For more information, see Chapter 4 Notes on Herbicides and Chapter 5 Notes on Adjuvants.)
flufenacet/ metribuzin AXIOM (68 DF) plus atrazine AATREX NINE-O (90 WG)	0.57 to 0.86 kg/ha 0.84 to 1.26 kg/ha 1 to 1.49 kg/ha 1.1 to 1.65 kg/ha	 0.34 to 0.5 kg/ac 0.44 to 0.66 kg/ac	▪ Apply PRE. ▪ **Do NOT** apply to coarse textured soils with less than 2% organic matter. ▪ **Do NOT use on seed corn or sweet corn.**
flufenacet/ metribuzin AXIOM (68 DF) plus dicamba BANVEL II (480 g/L)	0.57 to 0.86 kg/ha 0.84 to 1.26 kg/ha 0.6 kg/ha 1.25 L/ha	 0.34 to 0.5 kg/ac 0.5 L/ac	▪ Apply PRE. ▪ **Do NOT** apply to coarse textured soils with less than 2% organic matter. ▪ **Do NOT use on seed corn or sweet corn.**
flufenacet/ metribuzin AXIOM (68 DF) plus dicamba/ atrazine MARKSMAN ((1:2) 401 g/L)	0.57 to 0.86 kg/ha 0.84 to 1.26 kg/ha 1.4 to 1.72 kg/ha 3.5 to 4.3 L/ha	 0.34 to 0.5 kg/ac 1.4 to 1.72 L/ac	▪ Apply PRE. ▪ **Do NOT** apply to coarse textured soils with less than 2% organic matter. ▪ **Do NOT use on seed corn or sweet corn.**
dimethenamid FRONTIER (900 g/L) plus flumetsulam/clopyralid FIELDSTAR ((1:2.7) 85.6 WG)	1 to 1.125 kg/ha 1.1 to 1.25 L/ha 185 g/ha 216 g/ha	 0.44 to 0.5 L/ac 86 g/ac	▪ Apply PRE. ▪ See precautions for FIELDSTAR or FRONTIER used alone. ▪ **Do NOT apply to seed corn, popcorn or sweet corn.**
EPTC/ R25788 (EPTC+) ERADICANE (800 g/L) plus flumetsulam/clopyralid FIELDSTAR ((1:2.7) 85.6 WG)	3.4 to 4.4 kg/ha 4.25 to 5.5 L/ha 185 g/ha 216 g/ha	 1.7 to 2.2 L/ac 86 g/ac	▪ May be applied up to 15 days before planting but must be uniformly incorporated with equipment set to work at a depth of 5–8.5 cm. ▪ **Do NOT** use on soils with < 2% organic matter. ▪ **Do NOT** use on soils with pH > 7.8 or < 5.9. ▪ **Do NOT** apply to corn treated with a granular organophosphate insecticide. ▪ **Do NOT apply to seed corn, popcorn or sweet corn.**
isoxaflutole CONVERGE (75 WDG) plus atrazine CONVERGE 480 (480 g/L)	79 to 105 g/ha 105 to 140 g/ha 0.8 to 1.063 kg/ha 1.67 to 2.21 L/ha	 42 to 56 g/ac 0.67 to 0.88 L/ac	▪ Apply PRE. Use the higher application rates for control of fall panicum and suppression of proso millet. ▪ CONVERGE 75 WDG must be applied with CONVERGE 480. ▪ CONVERGE is a package containing CONVERGE 75 WDG and CONVERGE 480. ▪ Temporary yellowing of lower corn leaves may occur under adverse weather or soil conditions. ▪ **Do NOT** use CONVERGE on sands, loamy sands and/or soils with less than 2% organic matter. ▪ **Do NOT use on seed corn or sweet corn.**
linuron AFOLAN F (480 g/L)	1.8 to 2.26 kg/ha 3.75 to 4.7 L/ha	 1.5 to 1.88 L/ac	▪ Apply PRE. ▪ Plant corn at least 4 cm deep. Heavy rainfall and adverse weather conditions may result in temporary crop injury. ▪ Annual grasses, ragweed and velvetleaf are partially controlled but are the first to escape, particularly if low rates of the herbicide are used. ▪ Can be used on selected sweet corn varieties. ▪ **Do NOT** use on sandy soils.

linuron	1.082 kg/ha		▪ Apply PRE.
LOROX DF (50 DF)	2.2 kg/ha	0.88 kg/ac	▪ Use this tank-mix only on clay or clay loam soil to avoid injury. This tank-mix controls annual weeds including triazine resistant redroot pigweed and lamb's-quarters and is a method of reducing atrazine residues. Annual grasses will be the first weeds to escape.
or linuron	1.08 to 1.56 kg/ha		▪ See precautions for linuron alone.
LINURON 480 (480 g/L)	2.25 to 3.25 L/ha	0.9 to 1.3 L/ac	
plus atrazine	1.1 kg/ha		
ATRAZINE 480 (480 g/L)	2.29 L/ha	0.92 L/ac	
AATREX NINE-O (90 WG)	1.22 kg/ha	0.49 kg/ac	
pendimethalin	1.68 kg/ha		▪ Apply PRE.
PROWL 400 (400 g/L)	4.2 L/ha	1.68 L/ac	▪ PROWL alone will not control emerged weeds. Tank-mixing or use of a sequential herbicide program to achieve broad spectrum control is recommended. Plant corn at least 4 cm deep and ensure good seed coverage. PROWL maybe applied in water or liquid fertilizer (rate of 200 L liquid fertilizer/ha (80 L liquid fertilizer/ac)). A liquid fertilizer compatibility test is recommended with any of the registered PROWL tank-mix combinations. If rain is not received within 7 days, rotary hoeing or shallow cultivation is required.
			▪ **Do NOT use on seed corn or sweet corn.**
pendimethalin	1.68 kg/ha		▪ Apply PRE.
PROWL 400 (400 g/L)	4.2 L/ha	1.68 L/ac	▪ See precautions for PROWL alone.
plus atrazine	1.53 kg/ha		▪ **Do NOT use on sced corn or sweet corn.**
ATRAZINE 90W (90 WP)	1.7 kg/ha	0.68 kg/ac	
AATREX NINE-O (90 WG)	1.7 kg/ha	0.68 kg/ac	
pendimethalin	1.68 kg/ha		▪ Apply PRE.
PROWL 400 (400 g/L)	4.2 L/ha	1.68 L/ac	▪ See precautions for PROWL alone.
plus cyanazine	2.25 kg/ha		▪ **Do NOT use on seed corn or sweet corn.**
BLADEX 90 DF (90 DF)	2.5 kg/ha	1 kg/ac	
pendimethalin	1.68 kg/ha		▪ Apply PRE.
PROWL 400 (400 g/L)	4.2 L/ha	1.68 L/ac	▪ See precautions for PROWL alone and BANVEL II alone.
plus dicamba	0.6 kg/ha		▪ **Do NOT use on seed corn or sweet corn.**
BANVEL II (480 g/L)	1.25 L/ha	0.5 L/ac	
pendimethalin	1.68 kg/ha		▪ Apply PRE.
PROWL 400 (400 g/L)	4.2 L/ha	1.68 L/ac	▪ See precautions for PROWL alone and BANVEL II alone.
plus dicamba/atrazine	1.48 to 1.8 kg/ha		▪ **Do NOT use on seed corn or sweet corn.**
MARKSMAN ((1:2) 401 g/L)	3.7 to 4.5 L/ha	1.5 to 1.8 L/ac	
pendimethalin	1.68 kg/ha		▪ Apply PRE.
PROWL 400 (400 g/L)	4.2 L/ha	1.68 L/ac	▪ Sufficient rainfall to moisten the soil to a depth of 5 cm is necessary to move FIELDSTAR into the weed germination zone.
plus flumetsulam/clopyralid	185 g/ha		▪ **Do NOT** use on soils with pH > 7.8 or < 5.9.
FIELDSTAR ((1:2.7) 85.6 WG)	216 g/ha	86 g/ac	▪ **Do NOT** use on soils with less than 2% organic matter.
			▪ **Do NOT** apply to corn treated with a granular organophosphate insecticide.
			▪ **Do NOT apply to seed corn, popcorn, or sweet corn.**

Active ingredient TRADE NAME (Formulation)	RATE (active) PRODUCT PER HA	RATE PRODUCT PER ACRE	PRECAUTIONS (For more information see Chapter 4 Notes on Herbicides and Chapter 5 Notes on Adjuvants)
s-metolachlor/benoxacor DUAL II MAGNUM (915 g/L) plus atrazine ATRAZINE 480 (480 g/L) AATREX NINE-O (90 WG) or s-metolachlor/benoxacor/ atrazine PRIMEXTRA II MAGNUM ((1:0.8) 720 g/L)	1.14 to 1.6 kg/ha 1.25 to 1.75 L/ha 1.01 to 1.49 kg/ha 2.1 to 3.1 L/ha 1.12 to 1.65 kg/ha 2.16 to 2.88 kg/ha 3 to 4 L/ha	 0.5 to 0.7 L/ac 0.84 to 1.24 L/ac 0.45 to 0.66 kg/ac 1.2 to 1.6 L/ac	• Apply PPI or PRE. • DUAL II MAGNUM controls the grasses and atrazine controls the broadleaf weeds. When incorporated, DUAL II MAGNUM will control nutsedge for most of the season (10–14 weeks): mid season (July) germinating fall panicum may not be controlled. The high rate should be used where annual grass build up or nutsedge infestation is evident. The PPI application may not give full season control of fall panicum or velvetleaf.
s-metolachlor/benoxacor DUAL II MAGNUM (915 g/L) plus dicamba BANVEL II (480 g/L)	1.14 to 1.6 kg/ha 1.25 to 1.75 L/ha 0.6 kg/ha 1.25 L/ha	 0.5 to 0.7 L/ac 0.5 L/ac	• Apply PRE. • High rates should be used on heavy grass infestations and for fall panicum. Fall panicum may not be controlled all season. BANVEL controls velvetleaf, and triazine (atrazine, cyanazine or simazine) resistant broadleaf weeds. • See precautions for BANVEL II alone. • **Do NOT** use this tank-mix on sand or sandy soil. • **Do NOT use on seed corn or sweet corn.**
s-metolachlor/benoxacor DUAL II MAGNUM (915 g/L) plus dicamba BANVEL II (480 g/L) plus atrazine ATRAZINE 480 (480 g/L) AATREX NINE-O (90 WG)	1.14 to 1.6 kg/ha 1.25 to 1.75 L/ha 0.6 kg/ha 1.25 L/ha 1.01 to 1.49 kg/ha 2.1 to 3.1 L/ha 1.12 to 1.65 kg/ha	 0.5 to 0.7 L/ac 0.5 L/ac 0.84 to 1.24 L/ac 0.45 to 0.66 kg/ac	• Apply PRE. • High rates should be used on heavy grass infestations and for fall panicum. Fall panicum may not be controlled all season. BANVEL controls velvetleaf, and triazine (atrazine, cyanazine or simazine) resistant broadleaf weeds. • See precautions for BANVEL II alone. • **Do NOT** use this tank-mix on sand or sandy soil. • **Do NOT use on seed corn or sweet corn.**
s-metolachlor/benoxacor DUAL II MAGNUM (915 g/L) plus dicamba/atrazine MARKSMAN ((1:2) 401 g/L)	1.14 to 1.6 kg/ha 1.25 to 1.75 L/ha 1.48 to 1.8 kg/ha 3.7 to 4.5 L/ha	 0.5 to 0.7 L/ac 1.5 to 1.8 L/ac	• Apply PRE. • High rates should be used on heavy grass infestations and for fall panicum. Fall panicum may not be controlled all season. BANVEL controls velvetleaf, and triazine (atrazine, cyanazine or simazine) resistant broadleaf weeds. • See precautions for BANVEL II alone. • **Do NOT** use this tank-mix on sand or sandy soil. • Do NOT use on seed corn or sweet corn.
s-metolachlor/benoxacor DUAL II MAGNUM (915 g/L) plus flumetsulam/clopyralid FIELDSTAR ((1:2.7) 85.6 WG)	1.14 to 1.6 kg/ha 1.25 to 1.75 L/ha 185 g/ha 216 g/ha	 0.5 to 0.7 L/ac 86 g/ac	• May be applied PREPLANT up to 15 days before planting, PPI or PRE. • **Do NOT** move treated soil out of the row or move untreated soil to the surface during minimum or no to till planting or weed control will be diminished. When incorporated set equipment to uniformly work soil at a depth of 5–8.5 cm. Sufficient rainfall to moisten the soil to a depth of 5 cm is necessary to move PRE FIELDSTAR into the weed germination zone. • **Do NOT** use on soils with pH > 7.8 or < 5.9. • **Do NOT** use on soils with less than 2% organic matter. • **Do NOT** apply to corn treated with a granular organophosphate insecticide. • **Do NOT apply to seed corn, popcorn or sweet corn.**

s-metolachlor/benoxacor/ atrazine PRIMEXTRA II MAGNUM ((1:0.8) 720 g/L) plus dicamba BANVEL II (480 g/L)	2.16 to 2.88 kg/ha 3 to 4 L/ha 0.6 kg/ha 1.25 L/ha	 1.2 to 1.6 L/ac 0.5 L/ac	▪ Apply PRE. ▪ High rates should be used on heavy grass infestations and for fall panicum. Fall panicum may not be controlled all season. BANVEL controls velvetleaf, and triazine (atrazine, cyanazine or simazine) resistant broadleaf weeds. ▪ See precautions for BANVEL II alone. ▪ **Do NOT** use this tank-mix on sand or sandy soil. ▪ **Do NOT use on seed corn or sweet corn.**
s-metolachlor/benoxacor/ atrazine PRIMEXTRA II MAGNUM ((1:0.8) 720 g/L) plus flumetsulam/clopyralid FIELDSTAR ((1:2.7) 85.6 WG)	2.38 kg/ha 3.3 L/ha 185 g/ha 216 g/ha	 1.34 L/ac 86 g/ac	▪ May be applied up to 15 days before planting, PPI or PRE. ▪ **Do NOT** move treated soil out of the row or move untreated soil to the surface during minimum or no to till planting or weed control will be diminished. When incorporated set equipment to uniformly work soil at a depth of 5–8.5 cm. Sufficient rainfall to moisten the soil to a depth of 5 cm is necessary to move PRE FIELDSTAR into the weed germination zone. ▪ When incorporated, PRIMEXTRA II MAGNUM will control nutsedge for most of the season (10–14 weeks): mid season (July) germinating fall panicum may not be controlled. ▪ **Do NOT** use on soils with pH > 7.8 or < 5.9. ▪ **Do NOT** use on soils with < 2% organic matter. ▪ **Do NOT** apply to corn treated with a granular organophosphate insecticide. ▪ **Do NOT apply to seed corn, popcorn, or sweet corn.**
s-metolachlor/benoxacor/ atrazine PRIMEXTRA II MAGNUM ((1:0.8) 720 g/L) plus linuron AFOLAN F (480 g/L) LOROX DF (50 DF) LINURON 480 (480 g/L)	2.16 to 2.88 kg/ha 3 to 4 L/ha 0.37 to 0.75 kg/ha 0.78 to 1.56 L/ha 0.76 to 1.5 kg/ha 0.8 to 1.56 L/ha	 1.2 to 1.6 L/ac 0.31 to 0.62 L/ac 0.3 to 0.6 kg/ac 0.32 to 0.62 L/ac	▪ Apply PRE. ▪ This tank-mix can be used on light textured soils with OM greater than 1.0%. ▪ Linuron controls triazine resistant lamb's-quarters and redroot pigweed. Fall panicum or velvetleaf may not be controlled for the full season. ▪ **Do NOT use on seed corn or sweet corn**.
s-metolachlor/benoxacor DUAL II MAGNUM (915 g/L) plus linuron AFOLAN F (480 g/L) plus atrazine AATREX NINE-O (90 WG)	1.14 kg/ha 1.25 L/ha 0.38 to 0.75 kg/ha 0.8 to 1.56 L/ha 0.99 to 1.53 kg/ha 1.1 to 1.7 kg/ha	 0.5 L/ac 2 to 3.9 L/ac 0.45 to 0.69 kg/ac	▪ Use ONLY on sweet corn. ▪ Make only ONE application per year. ▪ Apply in a minimum of 150 L water/ha . ▪ Do NOT harvest sweet corn within 50 days of treatment. ▪ Apply by ground equipment only.

Active ingredient TRADE NAME Formulation	RATE (active) PRODUCT PER HA	RATE PRODUCT PER ACRE	PRECAUTIONS (For more information see Chapter 4 Notes on Herbicides and Chapter 5 Notes on Adjuvants)
simazine	1.35 to 2.25 kg/ha		▪ Apply PPI or PRE.
PRINCEP NINE to T (90 WG)	1.5 to 2.5 kg/ha	0.6 to 1 kg/ac	▪ These products are listed separately because of their widely differing rate ranges. In both cases the low rates should be used on sandy soils while the higher rates may be used on loams and clays. Full season annual weed control can be expected except for crabgrass or fall panicum where infestations have built up. Caution is advised that when considering rates beyond 2.0 kg/ha (0.8 kg/ac) as soil residues may be high. Read "Notes on atrazine and simazine soil residues" at the start of the corn section.
or simazine	1.6 to 4 kg/ha		
SIMADEX (500 g/L)	3.2 to 8 L/ha	1.28 to 3.2 L/ac	
SIMAZINE 480 (480 g/L)	3.4 to 8.3 L/ha	1.36 to 3.32 L/ac	
SIMAZINE 80W (80 WP)	2 to 2.75 kg/ha	0.8 to 1.1 kg/ac	▪ **Note**: Maximum registered Simazine 80W rate is 2.75 kg/ha (1.1 kg/ac) (2.2 kg/ha active).
Soil Applied Grass and Broadleaf Herbicides to for Clearfield (imazethapyr tolerant) hybrids only			
imazethapyr	0.075 kg/ha		▪ Use **ONLY** on imazethapyr tolerant "CLEARFIELD" corn.
PURSUIT (240 g/L)	0.312 L/ha	0.125 L/ac	▪ Apply PPI or PRE. ▪ Tank-mixing with another herbicide is recommended as a good weed management practice.
imazethapyr	0.075 kg/ha		▪ Use **ONLY** on imazethapyr tolerant "CLEARFIELD" corn.
PURSUIT (240 g/L)	0.312 L/ha	0.125 L/ac	▪ Apply PPI or PRE.
plus atrazine	1 to 1.5 kg/ha		
ATRAZINE 480 (480 g/L)	2.08 to 3.12 L/ha	0.83 to 1.25 L/ac	
AATREX NINE-O (90 WG)	1.11 to 1.67 kg/ha	0.44 to 0.67 kg/ac	
imazethapyr	0.075 kg/ha		▪ Use **ONLY** on imazethapyr tolerant "CLEARFIELD" corn.
PURSUIT (240 g/L)	0.312 L/ha	0.125 L/ac	▪ Apply PPI or PRE. ▪ A maximum rate of 2.25 kg ai/ha of cyanazine is allowed.
plus cyanazine	1.8 to 2.7 kg/ha		
BLADEX LIQUID (480 g/L)	3.75 to 5.5 L/ha	1.5 to 2.2 L/ac	
BLADEX 90 DF (90 DF)	2 to 3 kg/ha	0.8 to 1.2 kg/ac	
imazethapyr	0.075 kg/ha		▪ Use **ONLY** on imazethapyr tolerant "CLEARFIELD" corn.
PURSUIT (240 g/L)	0.312 L/ha	0.125 L/ac	▪ Apply PRE.
plus dicamba	0.6 kg/ha		
BANVEL II (480 g/L)	1.25 L/ha	0.5 L/ac	
imazethapyr	0.075 kg/ha		▪ Use **ONLY** on imazethapyr tolerant "CLEARFIELD" corn..
PURSUIT (240 g/L)	0.312 L/ha	0.125 L/ac	▪ Apply PRE.
plus pendimethalin	1.68 kg/ha		
PROWL 400 (400 g/L)	4.2 L/ha	1.68 L/ac	
Post-emergence Grass Herbicides			
dimethenamid	1 to 1.25 kg/ha		▪ Annual grasses should not be beyond the 2–leaf stage and corn should be at the spike to 3–leaf stage.
FRONTIER (900 g/L)	1.1 to 1.4 L/ha	0.44 to 0.56 L/ac	▪ **Do NOT** add oil or surfactants. ▪ **Do NOT use on seed corn, popcorn or sweet corn.**

nicosulfuron ACCENT (75 DF) plus non-ionic surfactant CITOWETT PLUS, AGRAL 90 or AG-SURF	25 g/ha 33 g/ha 2L/1000 L	 13 g/ac 2L/1000 L	▪ Always add water soluble packages to clean water with the agitator running. Corn should be within the 1–8 leaf stage of growth. Apply ACCENT when annual grasses are in the 1–6 leaf stage and/or quackgrass is in the 3–6 leaf stage (10–20 cm). ▪ The seed corn company must give approval for use on seed corn. ▪ **Do NOT** apply ACCENT to corn treated with organophosphorus insecticides. ▪ **Sweet Corn** to Corn should be in the 1–6 leaf stage (4 visible collars). USE ONLY on these cultivars: Bonus BT, Calicobelle, CNS 710, Elite, FTF243, FTF246, GH 2690 GSS 7831, and Krispy King. ▪ **Do NOT** apply on Delmonte 2038.
nicosulfuron/rimsulfuron ULTIM ((1:1 75 DF) plus non-ionic surfactant	25 g/ha 33 g/ha 2L/1000 L	 13g/ac 2L/1000 L	▪ Apply one water soluble bag/ha of ULTIM (ULTIM). Always add water soluble packages to clean water with the agitator running. Corn should be within the 1–6 leaf stage (30 cm). Apply ULTIM when annual grasses are in the 1–6 leaf stage, and/or quackgrass is in the 3–6 leaf stage (10–20 cm). ▪ **Do NOT** apply ULTIM to corn treated with organophosphorous insecticides. ▪ **Do NOT use on seed corn or sweet corn.**
rimsulfuron ELIM EP (25 DF) plus a non-ionic surfactant	15 g/ha 60 g/ha 2L/1000 L	 24 g/ac 2L/1000 L	▪ Always add water soluble packages to clean water with the agitator running. Corn should be within the spike to 3–leaf stage (20 cm). Apply ELIM EP when annual grasses are in the 1–4 leaf stage. ▪ **Do NOT** apply ELIM EP to corn treated with organophosphorous insecticides. ▪ **Do NOT apply to seed corn or sweet corn.**
s-metolachlor/benoxacor DUAL II MAGNUM (915 g/L)	1.14 to 1.6 kg/ha 1.25 to 1.75 L/ha	 0.5 to 0.7 L/ac	▪ Corn should be at the spike to 2– leaf stage and annual grasses not beyond 2–leaf stage. ▪ **Do NOT** add oil or surfactants.
Postemergence Broadleaf Herbicides			
2,4-D * 2,4-D (470 g/L)	0.28 to 0.56 kg/ha 0.6 to 1.2 L/ha	 0.24 to 0.48 L/ac	▪ Apply as an overall spray until corn is 15 cm high (leaf extended); thereafter, use drop nozzles. Use amine formulation. ▪ See special notes on postemergence use of 2,4-D and related hormone chemicals. ▪ **Do NOT** add oil or surfactant. ▪ **Do NOT use on seed corn or sweet corn.**
2,4-D/ dicamba/ mecoprop KIL-MOR (485 g/L)	0.41 to 0.53 kg/ha 0.85 to 1.1 L/ha	 0.34 to 0.44 L/ac	▪ Apply an overall spray until corn is 15 cm high (leaf extended): thereafter use drop nozzles. Jerusalem artichoke (30–40 cm in height) can be controlled with 2 sprays (10–14 days apart) per season for 2 seasons (see specific label instructions). ▪ See special notes on postemergence use of dicamba and related hormone chemicals. ▪ **Do NOT** add oil or surfactant. ▪ **Do NOT use on seed corn or sweet corn.**

Active Ingredient TRADE NAME Formulation	RATE (active) / PRODUCT PER HA	RATE PRODUCT PER ACRE	PRECAUTIONS For more information, see Chapter 4 Notes on Herbicides and Chapter 5 Notes on Adjuvants
2,4-DB CALIBER 400 (400 g/L) COBUTOX 600 (600 g/L) EMBUTOX 625 (625 g/L)	1.1 to 1.5 kg/ha 2.75 to 3.75 L/ha 1.66 to 2.5 L/ha 1.75 to 2.25 L/ha	 1.1 to 1.5 L/ac 0.66 to 1 L/ac 0.7 to 0.9 L/ac	▪ See precautions for MCPB/MCPA and special notes on postemergence use of 2,4-DB and related hormone chemicals. ▪ **Note**: The maximum label rate for EMBUTOX 625 is 2.25 L/ha (0.9 L/ac) of product. 2,4-DB will not control field horsetail. ▪ **Do NOT** add oil or surfactant. ▪ **Do NOT use on seed corn or sweet corn.**
atrazine AATREX (480 g/L) AATREX NINE-O (90 WG) ATRAZINE 480 (480 g/L) plus 2,4-D/ dicamba/ mecoprop KIL-MOR (485 g/L)	1.01 to 1.49 kg/ha 2.1 to 3.1 L/ha 1.12 to 1.65 kg/ha 2.1 to 3.1 L/ha 0.413 kg/ha 0.85 L/ha	 0.84 to 1.24 L/ac 0.45 to 0.66 kg/ac 0.84 to 1.24 L/ac 0.34 L/ac	▪ Apply as an overall spray until corn is 10 cm high (leaf extended) and before broadleaf weeds reach 10 cm in height. ▪ See special notes on postemergence use of dicamba and related hormone chemicals. ▪ **Do NOT** add oil or surfactant. ▪ **Do NOT apply to seed corn or sweet corn.**
atrazine AATREX (480 g/L) AATREX NINE-O (90 WG) plus bromoxynil PARDNER (280 g/L) KORIL (235 g/L)	1.01 to 1.49 kg/ha 2.1 to 3.1 L/ha 1.12 to 1.65 kg/ha 0.28 kg/ha 1 L/ha 1.2 L/ha	0.84 to 1.24 L/ac 0.45 to 0.66 kg/ac 0.4 L/ac 0.48 L/ac	▪ Apply from the 4–8 leaf stage of corn. A reduced rate of atrazine at 0.5 kg/ha (1/2 the low rate) can be used to control weeds listed for PARDNER (or KORIL) alone plus ragweed up to the 8–leaf stage, velvetleaf and triazine susceptible red root pigweed up to 6 leaves. ▪ Controls a wider spectrum of broadleaf weeds than PARDNER or KORIL alone; larger pigweed, ragweed and velvetleaf will be controlled. ▪ **Do NOT** add oil or surfactant. ▪ **Do NOT** use formulated atrazine/oil products in this tank-mixture. ▪ KORIL is not registered for use on seed corn.
atrazine ATRAZINE 480 (480 g/L) AATREX NINE-O (90 WG) plus bromoxynil/ MCPA BUCTRIL M ((1:1) 560 g/L) MEXTROL (400 g/L)	1.1 to 1.49 kg/ha 2.29 to 3.1 L/ha 1.22 to 1.65 kg/ha 0.56 kg/ha 1 L/ha 1.4 L/ha	 0.96 to 1.24 L/ac 0.49 to 0.66 kg/ac 0.4 L/ac 0.56 L/ac	▪ Apply from the 4–6 leaf stage of corn but injury may occur if applied after the 6–leaf stage. ▪ Controls a wider spectrum of broadleaf weeds than BUCTRIL M or MEXTROL alone; larger velvetleaf will be controlled. ▪ **Do NOT** add oil or surfactant. ▪ **Do NOT** use formulated atrazine/oil products in this tank-mixture. ▪ **Do NOT use on seed corn or sweet corn.**
atrazine ATRAZINE 480 (480 g/L) AATREX NINE-O (90 WG) plus dicamba BANVEL II (480 g/L)	1.01 to 1.49 kg/ha 2.1 to 3.1 L/ha 1.12 to 1.65 kg/ha 0.288 kg/ha 0.6 L/ha	 0.84 to 1.24 L/ac 0.45 to 0.66 kg/ac 0.24 L/ac	▪ This treatment will provide good to excellent control of broadleaf weeds including those triazine resistant and velvetleaf. Use the higher rate for residual control ▪ See special notes for corn regarding dicamba applications and precautions for BANVEL II alone POST. ▪ **Do NOT use on seed corn or sweet corn.**
atrazine ATRAZINE 480 (480 g/L) AATREX NINE-O (90 WG) plus pyridate LENTAGRAN (45 WP)	1.01 kg/ha 2.1 L/ha 1.12 kg/ha 0.45 kg/ha 1 kg/ha	 0.84 L/ac 0.45 kg/ac 0.4 kg/ac	▪ This combination can be applied as a sequential treatment with a preemergence grass herbicide or in fields without grass infestation. Only escaping grasses up to the 3–leaf stage are suppressed with this combination.

atrazine ATRAZINE 480 (480 g/L) ATRAZINE 90 W (90 WP) plus oil	1.01 to 1.49 kg/ha 2.1 to 3.1 L/ha 1.12 to 1.65 kg/ha 10 to 17 L/ha	 0.84 to 1.24 L/ac 0.45 to 0.66 kg/ac 4 to 6.8 L/ac	• For increased activity and extended period of activity, apply in an oil water emulsion of 10 to 17 L/ha (4 to 6.8 L/ac) of emulsifiable light mineral oil and 150–200 L/ha water (60–80 L/ac). Apply when most weeds have emerged. The low rate can be used successfully with later cultivation.
atrazine/2,4-D SHOTGUN ((2.3:1) 390 g/L)	0.936 to 1.404 kg/ha 2.4 to 3.59 L/ha	 0.96 to 1.44 L/ac	• Apply as an overall spray from the spike to the 4–leaf stage of corn. • **Do NOT** add oil or surfactant. • **Do NOT use on seed corn or sweet corn.**
bentazon BASAGRAN FORTE(480 g/L) or BASAGRAN (480 g/L) plus oil concentrate ASSIST	0.84 to 1.08 kg/ha 1.75 to 2.25 L/ha 1.75 to 2.25 L/ha 2 L/ha	 0.7 to 0.9 L/ac 0.7 to 0.9 L/ac 0.8 L/ac	• No adjuvant is required to be used with BASAGRAN FORTÉ. Reduce oil concentrate to 1 L/ha (0.4 L/ac) under hot, humid weather conditions. Control is best when the broadleaves are small and actively growing. Grasses are **NOT** controlled. • Top growth of nutsedge and Canada thistle are controlled and field bindweed may be suppressed by 2 applications of 1.75 L/ha (0.7 L/ac) (0.84 kg active/ha) applied 10 days apart. • Cool weather or drought may delay control.
bentazon/ atrazine LADDOK ((1:1) 400 g/L) plus oil concentrate ASSIST	0.8 to 1.6 kg/ha 2 to 4 L/ha 2 L/ha	0.8 to 1.6 L/ac 0.8 L/ac	• The recommended rate of 1.2 to 1.6 kg/ha of LADDOK (3 to 4 L/ha (1.2 to 1.6 L/ac) • LADDOK may be reduced to 0.8 to 1 kg/ha (2 to 2.5 L/ha (0.8 to 1 L/ac) LADDOK if metolachlor has been applied at the recommended rate for preemergence grass control. Use LADDOK at 3 to 4 L/ha (1.2 to 1.6 L/ac) for nutsedge control; repeat 7–10 days if necessary.
bromoxynil PARDNER (280 g/L) KORIL (235 g/L)	0.28 to 0.34 kg/ha 1 to 1.2 L/ha 1.2 to 1.4 L/ha	 0.4 to 0.48 L/ac 0.48 to 0.56 L/ac	• Controls most annual broadleaf weeds, including triazine resistant species at the 1–4 leaf stage. • PARDNER and KORIL are contact herbicides and are non volatile. • KORIL is not registered for use on seed corn.
bromoxynil PARDNER (280 g/L) plus dicamba BANVEL II (480 g/L)	0.28 kg/ha 1 L/ha 0.144 kg/ha 0.3 L/ha	 0.4 L/ac 0.12 L/ac	• Apply when the corn is in the 4–6 leaf stage as an overall treatment and up to 50 cm standing corn, using drop pipes. • Controls most annual broadleaf weeds including triazine resistant lamb's-quarters, pigweed and ragweed up to the 6–leaf stage. • See special notes on postemergence use of dicamba and precautions for BANVEL II alone POST. • Do NOT use on seed corn or sweet corn.
bromoxynil/ MCPA BUCTRIL M ((1:1) 560 g/L) MEXTROL (400 g/L)	0.558 kg/ha 1 L/ha 1.4 L/ha	 0.4 L/ac 0.56 L/ha	• Apply from the 4–6 leaf stage of corn but injury may occur if applied after the 6–leaf stage. • Controls most annual broadleaf weeds up to the 4–leaf stage (lamb's-quarters and mustards to 8–leaf stage). • Use in preference to PARDNER or KORIL when wild mustard is a particular problem. • **Do NOT use on seed corn or sweet corn.**

Active Ingredient TRADE NAME Formulation	RATE active ingredient PRODUCT PER HA	RATE PRODUCT PER ACRE	PRECAUTIONS For more information, see Chapter 4 Notes on Herbicides and Chapter 5 Notes on Adjuvants
dicamba BANVEL II (480 g/L)	0.288 to 0.6 kg/ha 0.6 to 1.25 L/ha	 0.24 to 0.5 L/ac	• Application of the lower rate can be made up to 20 cm standing corn. Drop pipes should be used when corn is 20–50 cm tall. The 0.6 kg/ha rate commonly referred to as the overlay treatment is particularly effective in controlling velvetleaf and providing extended residual control of other late germinating deep rooted broadleaf annuals and can be applied from the spike stage to the 5–leaf stage (13 cm standing corn). • See special notes on postemergence use of dicamba and related hormone chemicals. • **Do NOT** use dicamba if temperature exceeds 25°C at the time of application, or if high humidity is expected, due to the possibility of dicamba volatilizing and injury to susceptible crops nearby. • **Do NOT** add oil or surfactant. • **Do NOT use on seed corn or sweet corn.**
dicamba BANVEL II (480 g/L) plus 2,4-D 2,4-D (470 g/L)	0.14 kg/ha 0.29 L/ha 0.4 kg/ha 0.85 L/ha	 0.12 L/ac 0.34 L/ac	• Application can be made up to 10 cm standing corn. Drop pipes should be used when corn is 10–50 cm tall. Use amine formulation of 2,4-D. • See special notes on postemergence use of dicamba and 2,4-D and related hormone chemicals. • **Do NOT** add oil or surfactant. • **Do NOT use on seed corn or sweet corn.**
dicamba/atrazine MARKSMAN ((1:2) 401 g/L)	1.48 to 1.8 kg/ha 3.7 to 4.5 L/ha	 1.5 to 1.8 L/ac	• Application can be made up to 13 cm standing corn (5–leaf). Use the lower rate on coarse textured soils and the higher rate on medium to fine textured soils. • See special notes on postemergence use of dicamba and related hormone chemicals. • **Do NOT use on seed corn or sweet corn.**
diflufenzopyr/dicamba DISTINCT (70 WG) plus non-ionic surfactant plus liquid urea ammonium nitrate (UAN)	0.2 kg/ha 0.285 kg/ha 2.5 L/1000 L 12.5 L/1000 L	 0.115 kg/ac 2.5 L/1000 L 12.5 L/1000 L	• Apply to actively growing weeds when corn is in the 2–6 leaf stage. • Apply when temperatures above 4°C are predicted for the 24 hours before and after application. • **Do NOT** use on seed corn or sweet corn.
flumetsulam/clopyralid FIELDSTAR ((1:2.7) 85.6 WG) plus non-ionic surfactant	185 g/ha 216 g/ha 2.5 L/1000 L	 86 g/ac 2.5 L/1000 L	• Apply up to the 2–leaf stage of corn when broadleaf weeds are at the cotyledon to 2–leaf stage of growth. • Sufficient rainfall to moisten the soil to a depth of 5 cm is necessary to move FIELDSTAR into the weed germination zone to control those not yet emerged. • **Do NOT** use on soils with < 2% organic matter or a pH > 7.8 or < 5.9. • **Do NOT** apply to corn treated with a granular organophosphate insecticide. • **Do NOT apply to seed corn, popcorn or sweet corn.**

flumetsulam/clopyralid/2,4-D STRIKER ((1:2.7:5.4) 84.3 WG) plus non-ionic surfactant	236 g/ha 280 g/ha 2.5 L/1000 L	 112 g/ac 2.5 L/1000 L	• Apply up to the 6–leaf stage of corn when the majority of broadleaf weeds are at the 2–4 leaf stage of growth. Under dry growing conditions, use 28-0-0 or 32-0-0 liquid fertilizer (2.5% v/v, or 25 L per 1000 L or spray solution) together with non-ionic surfactant to provide enhanced control. • **Do NOT** apply when air temperature is near freezing or when freezing conditions are expected for several days following application. • **Do NOT** apply to corn treated with a granular organophosphate insecticide. • **Do NOT use on seed corn, popcorn or sweet corn.**
MCPA MCPA AMINE (500 g/L)	0.38 to 0.63 kg/ha 0.76 to 1.26 L/ha	 0.3 to 0.5 L/ac	• Controls triazine resistant and most other broadleaf weeds. Treat before the corn reaches 15 cm tall (leaf extended). Use the lower rate for small, actively growing weeds and the higher rate for larger weeds or under adverse weather conditions. Top growth of fully developed HORSETAIL (15–25 cm) can be controlled with 1 L/ha (0.4 L/ac) of product; a directed late post application using drop nozzles to avoid corn injury is necessary. • **Do NOT use on seed corn or sweet corn.**
MCPB/MCPA (15:1) TROPOTOX PLUS (400 g/L) CLOVITOX PLUS (400 g/L)	1.1 to 1.7 kg/ha 2.75 to 4.25 L/ha 2.75 to 4.25 L/ha	 1.1 to 1.7 L/ac 1.1 to 1.7 L/ac	• Apply when corn is 30–60 cm high, using drop pipes. Some control of field horsetail may be obtained with the higher rates of MCPB/MCPA. • See special notes on postemergence use of MCPB/MCPA and related hormone chemicals. • **Do NOT** add oil or surfactant. • **Do NOT use on seed corn or sweet corn.**
primisulfuron-methyl/ dicamba SUMMIT (47.4 WG) plus non-ionic surfactant	0.166 kg/ha 0.35 kg/ha 2 L/1000 L	 0.14 kg/ac 2 L/1000 L	• Corn should be within the 2–7 leaf stage. • Apply when the quackgrass is within the 3–6 leaf stage. • Controls quackgrass and most annual broadleaf weeds. Does not provide control of annual grasses. • Apply when temperature, during the 24 hours before and after application, ranges between 5°C and 28°C. • **Do NOT** use on seed corn or sweet corn. • **Do NOT** apply to corn treated with an organophosphate insecticide.
prosulfuron + dicamba PEAKPLUS[1] (PEAK (75 WG) + BANVEL II (480 g/L)) plus non-ionic surfactant	10 g/ha + 0.14 kg/ha 13.3 g/ha +03 L/ha 2 L/1000 L	 5.3 g/ac + 0.12 L/ac 2 L/1000 L	• Apply when the corn is in the 2–7 leaf stage. • Controls most annual broadleaf weeds including triazine resistant lamb's-quarters and pigweed up to the 6–leaf stage; cocklebur and velvetleaf up to the 6–leaf stage; and ragweed up to the 8–leaf stage. • AVAILABLE ONLY as a co to pack called PEAKPLUS to be applied with a non-ionic surfactant. • **Do NOT** apply to corn treated with organophosphorus insecticides. • **Do NOT apply to seed corn, popcorn or sweet corn.**

Active Ingredient / TRADE NAME Formulation	RATE Active / PRODUCT PER HA	RATE PRODUCT / PER ACRE	PRECAUTIONS For more information see Chapter 4 Notes on Herbicides and Chapter 5 Notes on Adjuvants
Postemergence Grass and Broadleaf Herbicides			
cyanazine BLADEX 90 DF (90 DF)	2.25 kg/ha 2.5 kg/ha	 1 kg/ac	• Use **ONLY** the dry flowable formulation, as the suspension may cause corn burning. • Corn injury may occur during cold weather and under flooding conditions. • **Do NOT** treat corn beyond the 3–leaf stage. • **Do NOT** add oil or surfactants.
cyanazine BLADEX 90 DF (90 DF) plus atrazine ATRAZINE 480 (480 g/L) AATREX (480 g/L) AATREX NINE-O (90 WG) plus dicamba BANVEL II (480 g/L)	1.8 to 2.25 kg/ha 2 to 2.5 kg/ha 1.1 kg/ha 2.29 L/ha 2.29 L/ha 1,22 kg/ha 0.288 kg/ha 0.6 L/ha	 0.8 to 1 kg/ac 0.92 L/ac 0.92 L/ac 0.49 kg/ac 0.24 L ac	• Use **ONLY** the dry flowable formulation of BLADEX. • The addition of atrazine will improve control of barnyard grass and pigweeds. Excellent control of annual grasses can be obtained if not beyond the 2–leaf stage at application. • **Do NOT** treat corn beyond 3–leaf stage. • **Do NOT** add oil or surfactant. • **Do NOT use on seed corn or sweet corn.**
cyanazine BLADEX 90 DF (90 DF) plus atrazine ATRAZINE 480 (480 g/L) ATRAZINE 90W (90WP) AATREX NINE-O (90 WG)	1.8 to 2.25 kg/ha 2 to 2.5 kg/ha 1.1 kg/ha 2.25 L/ha 1.22 kg/ha 1.22 kg/ha	 0.8 to 1 kg/ac 0.92 L/ac 0.49 kg/ac 0.49 kg/ac	• Use **ONLY** the dry flowable formulation of BLADEX. • Excellent control of annual weeds can be obtained if applied before grasses reach the 2–leaf stage. Use this triazine mixture where barnyard grass may be a problem. Use the low rate on coarse textured soils. • Corn injury may occur during cold weather and under flooding. • **Do NOT** treat corn beyond the 3–leaf stage. • **Do NOT** add oil or surfactants.
cyanazine BLADEX 90 DF (90 DF) plus dicamba BANVEL II (480 g/L)	2.25 kg/ha 2.5 kg/ha 0.288 kg/ha 0.6 L/ha	 1 kg/ac 0.24 L/ac	• Use **ONLY** the dry flowable formulation of BLADEX. • Excellent control of annual weeds can be obtained if applied before grasses reach the 2–leaf stage. Dicamba will control velvetleaf and triazine resistant broadleaf annual weeds. • **Do NOT** treat field corn beyond the 3–leaf stage. • **Do NOT** add oil or surfactant. • **Do NOT use on seed corn or sweet corn.**
dimethenamid FRONTIER (900 g/L) plus atrazine ATRAZINE 480 (480 g/L) AATREX NINE-O (90 WG) or plus cyanazine BLADEX 90 DF (90 DF)	1 to 1.25 kg/ha 1.1 to 1.4 L/ha 1.5 kg/ha 3.12 L/ha 1.67 kg/ha 2.25 kg/ha 2.5 kg/ha	 0.44 to 0.56 L/ac 1.25 L/ac 0.67 kg/ac 1 kg/ac	• Corn should be at the spike to 2–leaf stage and grasses should not be beyond the 2–leaf stage. Triazine resistant pigweed will be controlled. • Use only the dry flowable formulation of cyanazine. • **Do NOT** add oil or surfactants. • **Do NOT use on seed corn, popcorn or sweet corn.**

dimethenamid FRONTIER (900 g/L) plus dicamba BANVEL II (480 g/L) or plus dicamba/atrazine MARKSMAN ((1:2) 401 g/L)	1 to 1.25 kg/ha 1.1 to 1.4 L/ha 0.6 kg/ha 1.25 L/ha 1.8 kg/ha 4.5 L/ha	 0.44 to 0.56 L/ac 0.5 L/ac 1.8 L/ac	• Application can be made when the corn is in the spike to 2–leaf stage and annual grasses are not beyond the 2–leaf stage. • See special notes on postemergence use of dicamba and related hormone chemicals. • **Do NOT** use these tank-mixes on sandy soils or on sweet corn. • **Do NOT use on seed corn, popcorn or sweet corn.**
nicosulfuron ACCENT (75 DF) plus atrazine/2,4-D SHOTGUN ((2.3:1) 390 g/L) plus non-ionic surfactant	25 g/ha 33 g/ha 0.94 to 1.4 kg/ha 2.4 to 3.6 L/ha 2 L/1000 L	 13 g/ac 0.96 to 1.44 L/ac 2 L/1000 L	• Apply as an overall spray from 1–4 leaf stage of corn or 1–6 leaf stage of grasses. • See precautions for ACCENT. • **Do NOT use on seed corn, popcorn or sweet corn.**
nicosulfuron ACCENT (75DF) plus bromoxynil PARDNER (280 g/L) plus non-ionic surfactant	25 g/ha 33 g/ha 0.28 kg/ha 1 L/ha 2 L/1000 L	 13 g/ac 0.4 L/ac 2 L/1000 L	• Use only when the corn is between the 4 and 8–leaf stage. • See precautions for ACCENT and PARDNER.
nicosulfuron ACCENT (75DF) plus dicamba BANVEL II (480 g/L) plus non-ionic surfactant	25 g/ha 33 g/ha 0.288 kg/ha 0.6 L/ha 2 L/1000 L	 13 g/ac 0.24 L/ac 2 L/1000 L	• See precautions for ACCENT and BANVEL II. • **Do NOT** apply to corn beyond the 6–leaf stage.
nicosulfuron ACCENT (75DF) plus dicamba/ atrazine MARKSMAN ((1:2) 401 g/L) plus non-ionic surfactant	25 g/ha 33 g/ha 1 kg/ha 2.5 L/ha 2 L/1000 L	 13 g/ac 1 L/ac 2 L/1000 L	• See precautions for ACCENT and MARKSMAN. • **Do NOT** apply to corn beyond the 6–leaf stage.
nicosulfuron ACCENT (75 DF) plus diflufenzopyr/dicamba DISTINCT (70 WG) plus non-ionic surfactant plus liquid urea ammonium nitrate (UAN)	25 g/ha 33 g/ha 0.2 kg/ha 0.285 kg/ha 2.5 L/1000 L 12.5 L/1000 L	 13 g/ac 0.115 kg/ac 2.5 L/1000 L 12.5 L/1000 L	• Apply to active growth stage of seedling broadleaf weeds (less than 5 cm tall). • Apply to annual grasses in the 1–6 leaf stage and to quackgrass in the 3–6 leaf stage (10 to 20 cm). • Apply when temperatures above 4°C are predicted for the 24 hours before and after application. • Do NOT use on seed corn or sweet corn.
nicosulfuron plus prosulfuron + dicamba ACCENT ONE-PASS[1] (ACCENT (75 DF) plus PEAKPLUS (PEAK (75 WG) + BANVEL II (480 g/L))) plus non-ionic surfactant	25 g/ha 10 g/ha + 0.14kg/ha 33 g/ha 13.3 g/ha +0.3L/ha 2 L/1000 L	 13.3 g/ac 5.3 g/ac + 0.12 L/ac 2 L/1000 L	• Apply when the corn is in the 2–7 leaf stage. • PEAKPLUS is AVAILABLE ONLY as a co to pack to be applied with a non-ionic surfactant. • ACCENT ONE PASS is AVAILABLE ONLY as a co-pack with the PEAKPLUS co-pack. • **Do NOT** apply to corn treated with organophosphorus insecticides. • **Do NOT apply to seed corn, popcorn or sweet corn.**

Active ingredient(s) TRADE NAME Formulation	RATE (active) PRODUCT PER HA	RATE PRODUCT* PER ACRE	PRECAUTIONS (For more information, see Chapter 4 "Notes on Herbicides" and Chapter 5 "Notes on Adjuvants")
nicosulfuron/rimsulfuron ULTIM ((1:1) 75 DF) plus atrazine/2,4-D SHOTGUN ((2.3:1) 390 g/L) *plus non-ionic surfactant*	25 g/ha 33.7 g/ha 0.94 to 1.4 kg/ha 2.4 to 3.6 L/ha *2 L/1000 L*	 13.4 g/ac 0.96 to 1.44 L/ac *2 L/1000 L*	▪ Apply as an overall spray from 1–4 leaf stage of corn or 1–6 leaf stage of grasses. ▪ See precautions for ULTIM. ▪ **Do NOT use on seed corn, popcorn or sweet corn.**
nicosulfuron/rimsulfuron ULTIM ((1:1) 75 DF) plus bromoxynil PARDNER (280 g/L) plus atrazine ATRAZINE 480 (480 g/L) ATRAZINE (90 WG) plus non-ionic surfactant	25 g/ha 33 g/ha 0.14 kg/ha 0.5 L/ha 0.5 kg/ha 1.04 L/ha 0.56 kg/ha 2 L/1000 L	 13 g/ac 0.2 L/ac 0.42 L/ac 0.22 kg/ac 2 L/1000 L	▪ Apply from the 3–6 leaf stage of corn. ▪ One solupak of ULTIM treats 1 ha (2.5 ac). This treatment provides improved control of larger velvetleaf (up to 6–leaf stage) and common ragweed (up to 8–leaf stage) If grass and broadleaf weed growth stages do not coincide, then a sequential application of ULTIM and PARDNER plus atrazine is required. ▪ **Note:** some hybrids have shown sensitivity to ULTIM. ▪ **Do NOT** apply ULTIM to corn treated with organophosphorous insecticides. ▪ **Do NOT use on seed corn or sweet corn.**
nicosulfuron/rimsulfuron ULTIM ((1:1) 75 DF) plus bromoxynil PARDNER (280 g/L) plus non-ionic surfactant	25 g/ha 33 g/ha 0.28 kg/ha 1 L/ha 2 L/1000 L	 13 g/ac 0.4 L/ac 2 L/1000 L	▪ Apply from the 3–6 leaf stage of corn for optimum control. ▪ One solupak of ULTIM treats 1 ha (2.5 ac). Refer to product label(s) for weeds controlled, timing of application, and use precautions. If grass and broadleaf weed growth stages do not coincide, then a sequential application of ULTIM and PARDNER is required. ▪ **Note:** some hybrids have shown sensitivity to ULTIM. ▪ **Do NOT** apply ULTIM to corn treated with organophosphorous insecticides. ▪ **Do NOT use on seed corn or sweet corn.**
nicosulfuron/rimsulfuron ULTIM ((1:1) 75 DF) plus cyanazine BLADEX 90 DF (90 DF) plus non-ionic surfactant	25 g/ha 33 g/ha 0.75 kg/ha 0.83 kg/ha 2 L/1000 L	 13 g/ac 0.33 kg/ac 2 L/1000 L	▪ Apply from the 3–6 leaf stage of corn for optimum control. ▪ Use only the dry formulation of BLADEX. Refer to product label(s) for weeds controlled, timing of application, and use precautions. If grass and broadleaf weed growth stages do not coincide, then a sequential application of ULTIM and BLADEX is required. ▪ **Note:** some hybrids have shown sensitivity to ULTIM. ▪ **Do NOT** apply ULTIM to corn treated with organophosphorous insecticides. ▪ **Do NOT use on seed corn or sweet corn.**
nicosulfuron/rimsulfuron ULTIM ((1:1) 75 DF) plus dicamba BANVEL II (480 g/L) plus non-ionic surfactant	25 g/ha 33 g/ha 0.288 kg/ha 0.6 L/ha 2 L/1000 L	 13 g/ac 0.24 L/ac 2 L/1000 L	▪ Refer to product label(s) for weeds controlled, timing of application, and use precautions. If grass and broadleaf weed growth stages do not coincide, then a sequential application of ULTIM and BANVEL II is required. ▪ **Note:** some hybrids have shown sensitivity to ULTIM. ▪ **Do NOT** apply ULTIM to corn treated with organophosphorous insecticides. ▪ **Do NOT use on seed corn or sweet corn.**

nicosulfuron/rimsulfuron ULTIM ((1:1) 75 DF) plus dicamba/atrazine MARKSMAN ((1:2) 401 g/L) plus a non-ionic surfactant	25 g/ha 33 g/ha 1.003 kg/ha 2.5 L/ha 2 L/1000 L	 13 g/ac 1 L/ac 2 L/1000 L	• Apply up to the 5–leaf stage of corn. • Apply one water soluble bag/ha of ULTIM . If grass and broadleaf weed growth stages do not coincide, then a sequential application of ULTIM and MARKSMAN is required. • **Note:** some hybrids have shown sensitivity to ULTIM. • **Do NOT** apply to corn treated with organophosphorous insecticides. • **Do NOT use on seed corn or sweet corn.**
nicosulfuron/rimsulfuron ULTIM ((1:1) 75 DF) plus diflufenzopyr/dicamba DISTINCT (70 WG) plus non-ionic surfactant plus liquid urea ammonium nitrate (UAN)	25 g/ha 33 g/ha 0.2 kg/ha 0.285 kg/ha 2.5 L/1000 L 12.5 L/1000 L	 13 g/ac 0.115 kg/ac 2.5 L/1000 L 12.5 L/1000 L	• Apply to active growth stage of seedling broadleaf weeds (less than 5 cm tall). • Apply to annual grasses in the 1–6 leaf stage and to quackgrass in the 3–6 leaf stage (10–20 cm). • Apply when temperatures above 4°C are predicted for the 24 hours before and after application. • **Do NOT use on seed corn or sweet corn.**
nicosulfuron/rimsulfuron ULTIM ((1:1) 75 DF) plus flumetsulam/clopyralid/2,4-D STRIKER ((1:2.7:5.4) 84.3 WG) plus non-ionic surfactant	25 g/ha 33 g/ha 236 g/ha 280 g/ha 2.5 L/1000 L	 13 g/ac 112 g/ac 2.5 L/1000 L	• Apply up to the 6–leaf stage of corn. • ULTIM and STRIKER are packaged in unit area solupaks. Each solupak of ULTIM treats 1 ha (2.5 acres). Each solupak of STRIKER treats 0.8 ha (2 acres). • **Note:** some hybrids have shown sensitivity to ULTIM. • **Do NOT** apply to corn treated with an organophosphate insecticide. • **Do NOT use on seed corn or sweet corn.**
nicosulfuron/rimsulfuron + flumetsulam/clopyralid/2,4-D ULTIMAX (ULTIM ((1:1) 37.4) + MAX ((1:2.7:5.4) 84.3 WG)) plus non-ionic surfactant	25 g/ha + 236 g/ha 67 + 280 g/ha 2.5 L/1000 L	 27 + 112 g/ac 2.5 L/1000 L	• Apply up to the 6–leaf stage of corn. • ULTIMAX is a package of ULTIM (75 DF) and MAX (84.3 WG). Each water soluble bag of ULTIMAX treats 1 ha (2.5 acres). • **Note:** some hybrids have shown sensitivity to ULTIM. • **Do NOT** apply to corn treated with an organophosphate insecticide. • **Do NOT use on seed corn or sweet corn.**
nicosulfuron/rimsulfuron + flumetsulam/clopyralid/2,4-D ULTIM ((1.1) 75 DF) plus STRIKER ((1:2.7:5.4) 84.3 WG) or ULTIMAX[1] (ULTIM ((1.1) 37.4) + MAX ((1:2.7:5.4) 84.3 WG)) and plus atrazine ATRAZINE 90W (90WP) plus non-ionic surfactant	25 g/ha 236 g/ha 33.5 g/ha 280 g/ha 67 + 280 g/ha 0.5 kg/ha 0.555 kg/ha 2.5 L/1000 L	 13.5 g/ac 112 g/ac 27 + 112 g/ac 0.225 kg/ac 2.5 L/1000 L	• Apply up to the 6–leaf stage of corn. • ULTIM and STRIKER are packaged in unit area solupaks. Each solupak of ULTIM treats 1 ha (2.5 acres). Each solupak of STRIKER treats 0.8 ha (2 acres). • ULTIMAX is a co to pack of ULTIM (75 DF) and MAX (84.3 WG). Each water soluble bag of ULTIMAX treats 1 ha (2.5 acres). • **Note:** some hybrids have shown sensitivity to ULTIM. • **Do NOT** apply to corn treated with an organophosphate insecticide. • **Do NOT use on seed corn or sweet corn.**

Active ingredient TRADE NAME Formulation	RATE active PRODUCT PER HA	RATE PRODUCT PER ACRE	PRECAUTIONS For more information see Chapter 4 Notes on Herbicides and Chapter 5 Notes on Adjuvants
nicosulfuron/rimsulfuron	25 g/ha		▪ Apply to corn between the 2–6 leaf stage.
ULTIM (75 DF)	33 g/ha	13.3 g/ac	▪ AVAILABLE ONLY as a co to pack called PEAKPLUS to be applied with a non-ionic surfactant.
plus prosulfuron + dicamba	10 g/ha + 0.14kg/ha		▪ **Do NOT** apply to corn treated with organophosphorus insecticides.
PEAKPLUS[1] (PEAK (75 WG) + BANVEL II (480 g/L))	13.3 g/ha +0.3 L/ha	5.3 g/ac + 0.12 L/ac	▪ **Do NOT apply to seed corn, popcorn or sweet corn.**
plus non-ionic surfactant	2 L/1000 L	2 L/1000 L	
pendimethalin	1.68 kg/ha		▪ **Do NOT** apply to corn beyond the 4–leaf stage or annual grasses beyond the 2–leaf stage.
PROWL 400 (400 g/L)	4.2 L/ha	1.68 L/ac	▪ **Do NOT use on seed corn or sweet corn.**
plus atrazine	1.53 kg/ha		
ATRAZINE 90W (90WP)	1.7 kg/ha	0.68 kg/ac	
AATREX NINE-O (90 WG)	1.7 kg/ha	0.68 kg/ac	
pendimethalin	1.68 kg/ha		▪ Avoid application under adverse growing conditions.
PROWL 400 (400 g/L)	4.2 L/ha	1.68 L/ac	▪ **Do NOT** apply to corn beyond the 3–leaf stage or annual grasses beyond the 2–leaf stage.
plus cyanazine	2.25 kg/ha		▪ **Do NOT use on seed corn or sweet corn.**
BLADEX 90 DF (90 DF)	2.5 kg/ha	1 kg/ac	
pendimethalin	1.68 kg/ha		▪ Avoid application under adverse growing conditions. See precautions for BANVEL II alone POST.
PROWL 400 (400 g/L)	4.2 L/ha	1.68 L/ac	▪ **Do NOT** apply to corn beyond the 4–leaf stage or annual grasses beyond the 2–leaf stage.
plus dicamba	0.288 to 0.6 kg/ha		▪ **Do NOT** apply if temperature exceeds 25°C at application time.
BANVEL II (480 g/L)	0.6 to 1.25 L/ha	0.24 to 0.5 L/ac	▪ **Do NOT use on seed corn or sweet corn.**
pendimethalin	1.68 kg/ha		▪ See precautions for BANVEL II alone POST.
PROWL 400 (400 g/L)	4.2 L/ha	1.68 L/ac	▪ **Do NOT use on seed corn or sweet corn.**
plus dicamba/atrazine	1.48 to 1.8 kg/ha		
MARKSMAN ((1:2)401 g/L)	3.7 to 4.5 L/ha	1.5 to 1.8 L/ac	
rimsulfuron	15 g/ha		▪ Apply as an overall spray from 1–4 leaf stage of corn or 1–6 leaf stage of grasses.
ELIM EP (25 DF)	60 g/ha	24 g/ac	▪ See precautions for ELIM EP.
plus atrazine/2,4-D	0.936 to 1.4 kg/ha		▪ **Do NOT use on seed corn, popcorn or sweet corn.**
SHOTGUN ((2.3:1) 390 g/L)	2.4 to 3.6 L/ha	0.96 to 1.44 L/ac	
plus non-ionic surfactant	2 L/1000 L	2 L/1000 L	
rimsulfuron	15 g/ha		▪ Refer to product label(s) for weeds controlled, timing of application, and use precautions. If grass and broadleaf weed growth stages do not coincide, then a sequential application of rimsulfuron and dicamba is required.
ELIM EP (25 DF)	60 g/ha	24 g/ac	▪ **Do NOT use on seed corn or sweet corn.**
plus dicamba	0.288 kg/ha		
BANVEL II (480 g/L)	0.6 L/ha	0.24 L/ac	
plus non-ionic surfactant	2 L/1000 L	2 L/1000 L	
rimsulfuron	15 g/ha		▪ If grass and broadleaf weed growth stages do not coincide, then a sequential application of rimsulfuron and dicamba/atrazine is required.
ELIM EP (25 DF)	60 g/ha	24 g/ac	▪ **Do NOT use on seed corn or sweet corn.**
plus dicamba/atrazine	1.003 kg/ha		
MARKSMAN ((1:2) 401 g/L)	2.5 L/ha	1 L/ac	
plus a non-ionic surfactant	2 L/1000 L	2 L/1000 L	

rimsulfuron	12.5 g/ha		▪ Apply as an overall spray from 1–4 leaf stage of corn or 1–6 leaf stage of grasses ▪ See precautions for PROWL and ELIM EP. ▪ **Do NOT use on seed corn, popcorn or sweet corn.**
ELIM EP (25 DF)	50 g/ha	20 g/ac	
plus pendimethalin	1 kg/ha		
PROWL 400 (400 g/L)	2.5 L/ha	1 L/ac	
plus atrazine/2,4-D	1.404 kg/ha		
SHOTGUN ((2.3:1) 390 g/L)	3.6 L/ha	1.44 L/ac	
plus non-ionic surfactant	2 L/1000 L	2 L/1000 L	
rimsulfuron	12.5 g/ha		▪ Apply early postemergence to corn from the spike to 3–leaf stage (2 visible collars or 20 cm in height to leaf-extended). ▪ Refer to individual product labels for weeds controlled, timing of application and use precautions. In addition to other weeds this tank-mix will control yellow foxtail, crabgrass and Eastern black nightshade. ▪ **Do NOT use on seed corn or sweet corn.**
ELIM EP (25 DF)	50 g/ha	20 g/ac	
plus pendimethalin	1 kg/ha		
PROWL 400 (400 g/L)	2.5 L/ha	1 L/ac	
plus dicamba	0.3 kg/ha		
BANVEL II (480 g/L)	0.625 L/ha	0.25 L/ac	
plus non-ionic surfactant	2 L/1000 L	2 L/1000 L	
rimsulfuron	12.5 g/ha		▪ Apply early postemergence to corn from the spike to 3–leaf stage (2 visible collars or 20 cm in height to leaf-extended). ▪ Refer to individual product labels for weeds controlled and use precautions. This tank-mix will control yellow foxtail and crabgrass. ▪ **Do NOT use on seed corn or sweet corn.**
ELIM EP (25 DF)	50 g/ha	20 g/ac	
plus pendimethalin	1 kg/ha		
PROWL 400 (400 g/L)	2.5 L/ha	1 L/ac	
plus non-ionic surfactant	2 L/1000 L	2 L/1000 L	
s-metolachlor/benoxacor	1.14 to 1.6 kg/ha		▪ Apply when the corn is in the spike to 5–leaf stage and annual grasses are not beyond the 2–leaf stage. ▪ See special notes on postemergence use of dicamba and related hormone chemicals and precautions for BANVEL II alone POST. ▪ **Do NOT use on seed corn or sweet corn.**
DUAL II MAGNUM (915 g/L)	1.25 to 1.75 L/ha	0.5 to 0.7 L/ac	
plus atrazine	1.01 to 1.49 kg/ha		
AATREX NINE-O (90 WG)	1.12 to 1.65 kg/ha	0.45 to 0.66 kg/ac	
ATRAZINE 480 (480 g/L)	2.1 to 3.1 L/ha	0.84 to 1.24 L/ac	
plus dicamba	0.288 to 0.6 kg/ha		
BANVEL II (480 g/L)	0.6 to 1.25 L/ha	0.24 to 0.5 L/ac	
s-metolachlor/benoxacor	1.14 to 1.6 kg/ha		▪ Apply when the corn is in the spike to 6–leaf stage. ▪ High rates should be used for heavy grass infestation areas and for fall panicum control. ▪ **Do NOT** add oil or surfactants to this mixture.
DUAL II MAGNUM (915 g/L)	1.25 to 1.75 L/ha	0.5 to 0.7 L/ac	
plus atrazine	1.01 to 1.49 kg/ha		
ATRAZINE 480 (480 g/L)	2.1 to 3.1 L/ha	0.84 to 1.24 L/ac	
AATREX NINE-O (90 WG)	1.12 to 1.65 kg/ha	0.45 to 0.66 kg/ac	
or			
s-metolachlor/benoxacor/ atrazine	2.16 to 2.88 kg/ha		
PRIMEXTRA II MAGNUM ((1:0.8) 720 g/L)	3 to 4 L/ha	1.2 to 1.6 L/ac	
s-metolachlor/benoxacor	1.14 to 1.6 kg/ha		▪ Apply when the corn is in the spike to 5–leaf stage and annual grasses are not beyond the 2–leaf stage. ▪ See special notes on postemergence use of dicamba and related hormone chemicals and precautions for BANVEL II alone POST. ▪ **Do NOT use on seed corn or sweet corn.**
DUAL II MAGNUM (915 g/L)	1.25 to 1.75 L/ha	0.5 to 0.7 L/ac	
plus dicamba	0.288 to 0.6 kg/ha		
BANVEL II (480 g/L)	0.6 to 1.25 L/ha	0.24 to 0.5 L/ac	

Active ingredient TRADE NAME Formulation	RATE active PRODUCT PER HA	RATE PRODUCT PER ACRE	PRECAUTIONS For more information, see Chapter 4 Notes on Herbicides and Chapter 5 Notes on Adjuvants
s-metolachlor/benoxacor DUAL II MAGNUM (915 g/L) plus dicamba/ atrazine MARKSMAN ((1:2) 401 g/L)	1.14 to 1.6 kg/ha 1.25 to 1.75 L/ha 1.48 to 1.8 kg/ha 3.7 to 4.5 L/ha	 0.5 to 0.7 L/ac 1.5 to 1.8 L/ac	▪ Apply when the corn is in the spike to 5–leaf stage and annual grasses are not beyond the 2–leaf stage. ▪ See special notes on postemergence use of dicamba and related hormone chemicals. See precautions for BANVEL II alone POST. ▪ **Do NOT use on seed corn or sweet corn.**
s-metolachlor/benoxacor/ atrazine PRIMEXTRA II MAGNUM ((1:0.8) 720 g/L) plus dicamba BANVEL II (480 g/L)	2.16 to 2.88 kg/ha 3 to 4 L/ha 0.288 to 0.6 kg/ha 0.6 to 1.25 L/ha	 1.2 to 1.6 L/ac 0.24 to 0.5 L/ac	▪ Apply when the corn is in the spike to 5–leaf stage and annual grasses are not beyond the 2–leaf stage. ▪ See special notes on postemergence use of dicamba and related hormone chemicals and precautions for BANVEL II alone POST. ▪ **Do NOT use on seed corn or sweet corn.**
s-metolachlor/benoxacor/ atrazine PRIMEXTRA II MAGNUM ((1:0.8) 720 g/L) plus flumetsulam/clopyralid FIELDSTAR ((1:2.7) 85.6 WG)	2.38 kg/ha 3.3 L/ha 185 g/ha 216 g/ha	 1.34 L/ac 86 g/ac	▪ Apply up to the 2–leaf stage of corn when broadleaf weeds are at the cotyledon to 2 to leaf stage and annual grasses are at a maximum of 2–leaf. ▪ Sufficient rainfall to moisten the soil to a depth of 5 cm is necessary to move FIELDSTAR into the weed germination zone to control those not yet emerged. ▪ **Do NOT** use on soils with pH > 7.8 or < 5.9. ▪ **Do NOT** use on soils with < 2% organic matter. ▪ **Do NOT** apply to corn treated with a granular organophosphate insecticide. ▪ **Do NOT apply to seed corn, popcorn or sweet corn.**
Persistent Grass and Broadleaf Herbicides — for Clearfield (imazethapyr tolerant) hybrids only			
imazethapyr PURSUIT (240 g/L) plus non-ionic surfactant plus liquid fertilizer 28-0-0, 10-34-0, or 32-0-0	0.075 kg/ha 0.312 L/ha 2.5 L/1000 L 2 L/ha	 0.125 L/ac 2.5 L/1000 L 0.8 L/ac	▪ Use **ONLY** on imazethapyr tolerant "CLEARFIELD" corn. ▪ Apply when the weeds are up to the 2 true leaf stage. ▪ PURSUIT will provide residual weed control from soil activity. ▪ Some rotational cropping restrictions apply.
imazethapyr PURSUIT (240 g/L) plus atrazine ATRAZINE 480 (480 g/L) AATREX NINE-O (90 WG) or imazethapyr/atrazine PATRIOT ((1:8) 405 g/L) plus non-ionic surfactant plus liquid fertilizer 28-0-0, 10-34-0, or 32-0-0	0.075 kg/ha 0.312 L/ha 1 to 1.5 kg/ha 2.08 to 3.12 L/ha 1.11 to 1.67 kg/ha 0.665 kg/ha 1.64 L/ha 2.5 L/1000 L 2 L/ha	 0.125 L/ac 0.83 to 1.25 L/ac 0.44 to 0.67 kg/ac 0.66 L/ac 2.5 L/1000 L 0.8 L/ac	▪ Use **ONLY** on imazethapyr tolerant "CLEARFIELD" corn. ▪ Apply when the weeds are up to the 4 true leaf stage. ▪ PURSUIT will provide residual weed control from soil activity. ▪ Some rotational cropping restrictions apply.

imazethapyr	0.075 kg/ha		▪ Use **ONLY** on imazethapyr tolerant "CLEARFIELD" corn. ▪ Apply when the weeds are up to the 2 true leaf stage. ▪ PURSUIT will provide residual weed control from soil activity. ▪ Some rotational cropping restrictions apply.
PURSUIT (240 g/L)	0.312 L/ha	0.125 L/ac	
plus cyanazine	1.8 to 2.25 kg/ha		
BLADEX LIQUID (480 g/L)	3.75 to 4.75 L/ha	1.5 to 1.9 L/ac	
BLADEX 90 DF (90 DF)	2 to 2.5 kg/ha	0.8 to 1 kg/ac	
plus non-ionic surfactant	2.5 L/1000 L	2.5 L/1000 L	
plus liquid fertilizer			
28-0-0, 10-34-0, or 32-0-0	2 L/ha	0.8 L/ac	
imazethapyr	0.075 kg/ha		▪ Use **ONLY** on imazethapyr tolerant "CLEARFIELD" corn. ▪ Apply when the weeds are up to the 4 true leaf stage. ▪ PURSUIT will provide residual weed control from soil activity. ▪ Some rotational cropping restrictions apply . See precautions for BANVEL II alone POST.
PURSUIT (240 g/L)	0.312 L/ha	0.125 L/ac	
plus dicamba	0.288 to 0.6 kg/ha		
BANVEL II (480 g/L)	0.6 to 1.25 L/ha	0.24 to 0.5 L/ac	
plus non-ionic surfactant	2.5 L/1000 L	2.5 L/1000 L	
plus liquid fertilizer			
28-0-0, 10-34-0, or 32-0-0	2 L/ha	0.8 L/ac	
imazethapyr	0.075 kg/ha		▪ Use **ONLY** on imazethapyr tolerant "CLEARFIELD" corn. ▪ Apply when the weeds are up to the 4 true leaf stage. ▪ PURSUIT will provide residual weed control from soil activity. ▪ Some rotational cropping restrictions apply. See precautions for BANVEL II alone POST.
PURSUIT (240 g/L)	0.312 L/ha	0.125 L/ac	
plus dicamba/atrazine	1.4 to 1.74 kg/ha		
MARKSMAN ((1:2)401 g/L)	3.5 to 4.33 L/ha	1.4 to 1.73 L/ac	
plus non-ionic surfactant	2.5 L/1000 L	2.5 L/1000 L	
plus liquid fertilizer			
28-0-0, 10-34-0, or 32-0-0	2 L/ha	0.8 L/ac	
imazethapyr	0.075 kg/ha		▪ Use **ONLY** on imazethapyr tolerant "CLEARFIELD" corn. ▪ Apply when the weeds are up to the 2 true leaf stage. ▪ PURSUIT will provide residual weed control from soil activity. ▪ Some rotational cropping restrictions apply.
PURSUIT (240 g/L)	0.312 L/ha	0.125 L/ac	
plus pendimethalin	1.68 kg/ha		
PROWL 400 (400 g/L)	4.2 L/ha	1.68 L/ac	
plus non-ionic surfactant	2.5 L/1000 L	2.5 L/1000 L	
plus liquid fertilizer			
28-0-0, 10-34-0, or 32-0-0	2 L/ha	0.8 L/ac	
Postemergence Grass and Broadleaf Herbicides — for Liberty Link (glufosinate tolerant) hybrids only			
glufosinate ammonium	0.3 to 0.5 kg/ha		▪ Use **ONLY** on field and seed corn specially developed to be tolerant to LIBERTY 200 SN. ▪ LIBERTY 200 SN can be applied from the 1–8 leaf stage of corn. ▪ LIBERTY 200 SN is a contact herbicide and has no residual activity. Consult the product label for rate recommendations for specific weeds and weed stages. Ammonium sulphate can be applied at 6 L/ha (2.4 L/ac)(liquid) or 3.3 kg/ha (1.3 kg/ac)(dry) for improved control of specific weeds. ▪ **Do NOT** add oil or any other surfactants.
LIBERTY 200 SN (200 g/L)	1.5 to 2.5 L/ha	0.6 to 1 L/ac	

Active ingredient TRADE NAME formulation	RATE active PRODUCT PER HA	RATE PRODUCT PER ACRE	PRECAUTIONS For more information, see Chapter 4 Notes on Herbicides and Chapter 5 Notes on Adjuvants
glufosinate ammonium LIBERTY 200 SN (200 g/L) plus atrazine ATRAZINE 480 (480 g/L) AATREX NINE-O (90 WG)	0.3 to 0.5 kg/ha 1.5 to 2.5 L/ha 0.84 to 1.12 kg/ha 1.75 to 2.34 L/ha 0.94 to 1.24 kg/ha	 0.6 to 1 L/ac 0.7 to 0.93 L/ac 0.37 to 0.5 kg/ac	▪ Use **ONLY** on field and seed corn specially developed to be tolerant to LIBERTY 200 SN. ▪ This tank-mix can be applied up to the 8–leaf stage of corn.
glufosinate ammonium LIBERTY 200 SN (200 g/L) plus dicamba BANVEL II (480 g/L)	0.3 to 0.5 kg/ha 1.5 to 2.5 L/ha 0.3 kg/ha 0.625 L/ha	 0.6 to 1 L/ac 0.25 L/ac	▪ Use **ONLY** on field and seed corn specially developed to be tolerant to LIBERTY 200 SN. ▪ This tank-mix can be applied up to the 8–leaf stage of corn. ▪ See precautions for BANVEL II alone POST.
glufosinate ammonium LIBERTY 200 SN (200 g/L) plus dicamba/atrazine MARKSMAN ((1:2)401 g/L)	0.3 to 0.5 kg/ha 1.5 to 2.5 L/ha 1 to 1.5 kg/ha 2.5 to 3.7 L/ha	 0.6 to 1 L/ac 1 to 1.5 L/ac	▪ Use **ONLY** on field and seed corn specially developed to be tolerant to LIBERTY 200 SN. ▪ This tank-mix can be applied up to the 5–leaf stage of corn. ▪ See precautions for BANVEL II alone POST.
glufosinate ammonium LIBERTY 200SN (200 g/L) followed by glufosinate ammonium LIBERTY 200SN (200 g/L)	0.4 kg/ha 2 L/ha 0.25 kg/ha 1.25 L/ha	 0.8 L/ac 0.5 L/ac	▪ Use **ONLY** on field and seed corn specially developed to be tolerant to LIBERTY 200 SN. ▪ The first application may be applied on 4–5 leaf corn at the proper growth stage of the weeds. The second application may be made up to the 8–leaf stage of corn to control subsequent flushes of weeds.
glufosinate ammonium LIBERTY 200SN (200 g/L) plus pendimethalin PROWL 400 (400 g/L)	0.3 to 0.5 kg/ha 1.5 to 2.5 L/ha 1 kg/ha 2.5 L/ha	 0.6 to 1 L/ac 1 L/ac	▪ Use **ONLY** on field and seed corn specially developed to be tolerant to LIBERTY 200 SN. ▪ This tank-mix can be applied up to the 4–leaf stage of corn.
glufosinate ammonium plus s-metolachlor/benoxacor/ atrazine LIBERTYPRIME[1] (LIBERTY 200 SN (200 g/L) plus PRIMEXTRA II MAGNUM ((1:0.8) 720 g/L))	0.3 to 0.5 kg/ha 2.16 to 2.88 kg/ha 1.5 to 2 L/ha 3 to 4 L/ha	 0.6 to 0.8 L/ac 1.2 to 1.6 L/ac	▪ Use **ONLY** on field corn specially developed to be tolerant to LIBERTY 200 SN. ▪ This tank-mix can be applied up to the 6–leaf stage of corn. ▪ AVAILABLE ONLY as a co-pack called LIBERTYPRIME ▪ To ensure optimal compatibility **ONLY** use PRIMEXTRA II MAGNUM found in the co-pack
For Quackgrass Grass and Broadleaf Herbicides — for Roundup Ready (glyphosate tolerant) hybrids only			
glyphosate ROUNDUP TRANSORB (360 g/L) VANTAGE PLUS (360 g/L)	0.9 kg/ha 2.5 L/ha 2.5 L/ha	 1 L/ac 1 L/ac	▪ Use **ONLY** with pedigreed (certified) corn seed designated as "ROUNDUP READY CORN". ▪ Apply up to and including the 8–leaf stage of corn. ▪ The initial application is recommended between the 2–6 leaf stage (3–5 leaf is optimum timing) to remove early competition. A second application may be applied up to the 8–leaf stage of corn (8–leaf fully expanded). ▪ Use 100–200 L/ha (40–80 L/ac) of water.

Directed Postemergence			
2,4-D/ dicamba/ mecoprop KIL-MOR (485 g/L)	0.42 to 0.53 kg/ha 0.85 to 1.1 L/ha	 0.34 to 0.44 L/ac	• Apply an overall spray until corn is 15 cm high (leaf extended): thereafter use drop nozzles. • Jerusalem artichoke (30–40 cm in height) can be controlled with 2 sprays (10–14 days apart) per season for 2 seasons (see specific label instructions). • See special notes on postemergence use of dicamba and related hormone chemicals. • **Do NOT** add oil or surfactant. • **Do NOT use on seed corn or sweet corn.**
linuron AFOLAN F (480 g/L) LOROX DF (50 DF) LINURON 480 (480 g/L)	1.1 to 2.25 kg/ha 2.3 to 4.7 L/ha 2.2 to 4.5 kg/ha 2.4 to 4.5 L/ha	 0.92 to 1.88 L/ac 0.88 to 1.8 kg/ac 0.96 to 1.8 L/ac	• Apply in oil water emulsion as directed spray at low pressure with drop nozzles after corn is 30 cm or more in height. • The spray must be placed under the corn leaves but on the weeds. Use this treatment as a rescue from weeds escaping a previous treatment and for nutsedge or horsetail top growth burn down. • **Do not** apply linuron after corn is beginning to tassel.
MCPA MCPA AMINE (500 g/L)	0.38 to 0.63 kg/ha 0.76 to 1.26 L/ha	 0.3 to 0.5 L/ac	• Controls triazine resistant and most other broadleaf weeds. • Use the lower rate for small, actively growing weeds and the higher rate for larger weeds or under adverse weather conditions. Top growth of fully developed **horsetail** (15–25 cm) can be controlled with 1 L/ha (0.4 L/ac) of product; a directed late post application using drop nozzles to avoid corn injury is necessary. • **Do NOT use on seed corn or sweet corn.**
nicosulfuron/rimsulfuron ULTIM ((1:1) 25 DF) plus bromoxynil PARDNER (280 g/L) plus non-ionic surfactant	25 g/ha 100 g/ha 0.28 kg/ha 1 L/ha 2 L/1000 L	 40 g/ac 0.4 L/ac 2 L/1000 L	• Apply before the corn reaches 15 cm tall (leaf extended). • Delay application until 8–leaf stage of corn, when a height differential can be established between the corn and target weeds. Application should be made before the initiation of corn silking. Direct spray solution below crop canopy. Apply one water soluble bag/ha of ULTIM. • Provides later season quackgrass control. • **Do NOT use on seed corn or sweet corn.**
nicosulfuron/rimsulfuron ULTIM ((1:1) 37.4 DF) plus non-ionic surfactant	25 g/ha 67 g/ha 2 L/1000 L	 27 g/ac 2 L/1000 L	• Delay application until 8–leaf stage of corn, when a height differential can be established between the corn and target weeds. Application should be made before the initiation of silking. Direct spray solution below crop canopy. Apply one water soluble bag/ha of ULTIM. • Provides later season quackgrass control. • **Do NOT use on seed corn or sweet corn.**

Active ingredient TRADE NAME (Formulation)	RATE active / PRODUCT PER HA	RATE PRODUCT PER ACRE	PRECAUTIONS (For more information, see Chapter 4, Notes on Herbicides and Chapter 5, Notes on Adjuvants)
[illegible] — for LIBERTY tolerant hybrids only			
glufosinate ammonium LIBERTY 200 SN (200 g/L)	0.3 to 0.5 kg/ha 1.5 to 2.5 L/ha	0.6 to 1 L/ac	▪ Use **ONLY** on field and seed corn specially developed to be tolerant to LIBERTY. ▪ Application after the 8–leaf stage of corn must be made as a directed spray below the whorl of the corn plant. ▪ LIBERTY is a contact herbicide and has no residual soil activity. Consult the product label for rate recommendations for specific weeds and weed stages. Ammonium sulphate can be added at 6 L/ha (2.4 L/ac)(liquid) or 3.3 kg/ha (1.3 kg/ac)(dry) for improved control of specific weeds. ▪ **Do NOT** add oil or any other surfactants.
[illegible]			
glyphosate * glyphosate (360 g/L)	1.71 to 2.52 kg/ha 4.75 to 7 L/ha	1.9 to 2.8 L/ac	▪ Apply after Canada thistle has started flowering. Quackgrass should be actively growing. ▪ Corn will be killed in the areas sprayed and may be damaged by spray drift in adjacent areas. ▪ Knapsack application of 100 mL of glyphosate* product in 5 L of water applied to thoroughly wet the foliage, but not to runoff, is suggested for small areas to reduce drift and area of corn killed. ▪ **Do NOT** apply after corn has started to silk.
glyphosate * glyphosate (360 g/L)	2.52 to 4.32 kg/ha 7 to 12 L/ha	2.8 to 4.8 L/ac	▪ Apply after field bindweed has reached full flowering, or milkweed has reached the bud stage. Quackgrass should be actively growing. ▪ Corn will be killed in the areas sprayed and may be damaged by spray drift in adjacent areas. Knapsack application of 100 mL of glyphosate* product in 5 L of water applied to thoroughly wet the foliage, but not to runoff, is suggested for small areas to reduce drift and area of corn killed. ▪ **Do NOT** apply after corn has started to silk.

* Various formulations available, see Table 1. See label for specific uses and rates.

Corn Leaf Stages

Counting the leaves on a corn plant sounds like an easy task but there are a few complications that can cause you to miscount. It is important when reading labels or other information to know which leaf counting method they are referring to.

There are several methods of counting leaves. One method counts all leaves including any leaf tip that has emerged from the whorl at the top of the plant (leaf tip method). Another method only counts those leaves that are fully emerged and have the leaf collar showing (leaf collar method). The leaf collar is a light green band that separates the leaf blade and leaf sheath that wraps around the stem. In some states they refer to corn growth stages as V1, V2, V3, etc., where a V3 stage is a plant with 3 collars showing.

In Guide to Weed Control, we are counting leaves that have emerged from the whorl and the leaf tip is starting to arch over (leaf over method). This normally occurs when leaves are about 50% emerged. Most product labels also refer to this method of leaf counting but check the label or with the product representative to be sure. The Comparative Growth stages table in the next column gives a comparison among the count methods.

Another complication with leaf counting is that we start with the bottom leaf known as the first leaf. The first leaf is shorter than other leaves and has a round leaf tip. However, as the plant grows the bottom leaves start to die and drop to the ground. A 10 to leaf corn plant may have one to three leaves that have died. These leaves may not be immediately apparent and care must be taken to count them.

Hint: Start counting from the bottom leaf, and check the first leaf to look for the rounded leaf tip.

It takes about 75–80 Crop Heat Units to produce each corn leaf. Therefore at temperatures of 30°C day, and 20°C at night, there is one new leaf every 2–3 days; and at 20°C day, and 10°C at night, one new leaf every 5–6 days.

Critical Stage: The Critical Stage to control weeds in corn is the 2–8 leaf over stage (3–10 leaf tips).

Some product labels also use plant height to indicate crop growth stages. In general, plant height is more variable depending on plant genetics and on the weather of the season. The following table gives some comparative heights for each leaf stage but your plants may be slightly more or less than the stage given depending on genetics and weather. The standing height is measured from the ground surface to the top of the plant as it stands. Leaf extended refers to the height of the plant with the leaves pulled up to their full height.

Comparative Growth Stages

Leaf over	Collars	Leaf tips	Standing Height (cm)	Leaf Extended (cm)
2	1	3	5–6	5–11
4	3	5–6	9–17	16–25
6	4–5	7–8	18–33	29–46
8	5–6	9–10	36–54	54–77
10	8	12	58–85	86–112
12	10	14–15	99–114	121–149

Stages Of Corn Leaf Development (leaf over method)

TABLE 11 Corn Postemergence Herbicides Leaf Stages

Trade Name	Stage of Corn (leaf-over stage)	Annual Grasses						Annual Broadleaf										Perennials
		barnyard grass	crabgrass	fall panicum	green foxtail	wild witchgrass	proso millet	buckwheat, wild	cocklebur	jimsonweed	lady's-thumb	lamb's-quarters	wild mustard	nightshade	pigweed	ragweed	velvetleaf	quackgrass
ACCENT	1–8	6		6	6	6	6											3–6
ACCENT 1-PASS [1]	1–7	6		6	6	6	6		6		4	6	12		6	8	6	3–6
ELIM	spike–3	1–4													2–4			
LIBERTY	up to 8	5	5	4	5	4	5		4		6	6	4		6	7	4	1–4
ULTIM	1–6	6		6	6	6	6											3–6
ULTIMAX [1]	1–6	6		6	6	6	6		2–4		2–4	2–4	2–4		2–6	2–4	2–4	3–6
atrazine	tolerant at all stages									10 cm	10 cm	10 cm	10 cm	10 cm	10 cm	7–10 cm	5–10 cm	
BANVEL II	up to 5							4	4	4	4	4	4	4	4	4	4	
BANVEL II + atrazine	up to 5							4	6	6	6–8	6	6	6	6	6	6	
BUCTRIL M, MEXTROL	4–6							8	4		4	8	8		4	8	4	
DISTINCT	2–6							6	6	6	6–8	6	6	6	6	6	6	
LIBERTYPRIME [1]	2–6	5	5	4	5	4	5		4		6	6	4		6	7	4	1–4
PARDNER, KORIL	4–8							8	4		4	8	4		4	4	4	
PARDNER, KORIL + atrazine	4–8							8	4		4	8	4		6	8	6	
PEAKPLUS [1]	up to 6								6		4	6	12		6	8	6	
ROUNDUP TRANSORB	up to 8	25 cm	25 cm	25 cm	25 cm	25 cm	25 cm	25 cm	25 cm	25 cm	15 cm	25 cm	25 cm	25 cm	25 cm	25 cm	25 cm	25 cm
SHOTGUN	spike–4							1–6			1–6	1–6	1–6		1–6	1–6	1–6	
STRIKER	up to 6								2–4	2–4		2–4	2–4		2–4	2–4	2–4	
SUMMIT	2–7											2–6	2–7		2–8	2–6	2–4	3–6

[1] Indicates herbicide sold as a co-pack under this trade name

Expressed as leaf stages except as indicated

Notes:

Weed control ratings are given as 0–9 where 0 indicates no control and 9 indicates 90%–100% control under ideal conditions.

Ratings are subjective values based on best available information and give general comparisons based on use as descibed in this guide.

Crop tolerance ratings are E - Excellent, G - Good, F - Fair, P - Poor.

Under unfavorable conditions (eg., too dry, too wet, too cold, or poor application) the herbicides may not be as effective as indicated.

Ratings may vary with weed and crop stage and with the timing and rates of the product(s) being used.

Ratings in **BOLD** indicate the weed is listed on the product label for control or suppression.

Please see product label for more information on registered weed species, product uses and precautions.

Table 12. Corn (Field and Sweet) Herbicide Weed Control Ratings

Trade Name	Crop			Annual Grasses								Annual Broadleaves												Perennials							Crop Tolerance
	seed corn	sweet corn	field corn	barnyard grass	crabgrass	fall panicum	foxtail, giant	foxtail, green	foxtail, yellow	old witch grass	proso millet	buckwheat, wild	cocklebur	corn spurry	fleabane, Canada	lady's thumb	lamb's-quarters	mustards	nightshades	pigweeds	ragweed, common	ragweed, giant	velvetleaf	bindweed, field	horsetail	milkweed	nutsedge	quackgrass	sow-thistle	thistle, Canada	
AXIOM			✓	9	9	8/9[a]	8	9	9	9	4	?	?	?	?	8	8	9	8	8	7	6	6	?	0	0	7	0	0	0	E
DUAL II MAGNUM	✓	✓	✓	9	9	8/9[a]	8	9	9	9	4	2	2	2	?	2	7	2	8/9[c]	7/8	4	3	3	0	0	0	8/9[b]	0	0	0	E
ERADICANE		✓	✓	9	9	8	8	9	9	9	7	2	4	8	?	7	8	2	8	7	7	?	4	2	7	0	8[a]	2[a]	2	2	E
FRONTIER	✓	✓	✓	9	9	8/9[a]	8	9	9	9	4	2	2	2	?	2	7	2	8/9[c]	7/8	4	3	3	0	0	0	8/9[b]	0	0	0	E
PROWL			✓	9	8	9	8	8	8	?	5	?	?	?	?	6	9	0	8	8	2	?	6	?	?	?	?	?	?	?	E
AFOLAN F		✓	✓	7	7	7	7	7	7	7	2	9	5	?	?	9	9	9	8	9	8	?	5	0	0	0	0	0	0	0	G
atrazine*	✓	✓	✓	7	4	4	7	7	7	7	2	9	7	9	?	9	9	9	9	9	9	?	5	2	0	0	0	2	2	0	E
BANVEL II			✓	0	0	0	0	0	0	0	0	8	8	8	?	9	9	8	9	9	9	?	8	2	0	0	0	0	2	2	G
BLADEX	✓	✓	✓	7	9	8	7	7	7	9	2	8	7	?	?	8	9	9	9	7	8	?	5	0	0	0	0	0	0	0	E
FIELDSTAR			✓	0	0	0	0	0	0	0	0	9	9	?	8	9	9	9	9	9	9	?	9	0	0	0	0	0	7	7	E
MARKSMAN			✓	7	4	4	7	7	7	7	2	9	8	9	?	9	9	9	9	9	9	?	8	2	0	0	0	2	2	2	G
PRINCEP NINE-T, SIMADEX, SIMAZINE 480	✓	✓	✓	9	8	7	9	9	9	9	2	9	7	9	?	9	9	9	9	9	8	?	5	2	0	0	5	5	2	2	E
CONVERGE [1]			✓	9	9	9	9	9	9	9	8	8	?	?	8	9	9	9	9	9	9	?	9	?	0	0	0	0	0	0	G
PRIMEXTRA II MAGNUM	✓	✓	✓	9	9	8/9[a]	8	9	9	9	2	9	7	9	?	9	9	9	9	9	9	?	7	0	0	0	8/9[b]	0	0	0	E
PURSUIT [2]			✓[2]	8	7	7	9	9	9	9	7	8	6	?	?	9	9	9	9	9	8	?	9	?	?	?	7	5	?	?	E[2]

Table 12. Corn (Field and Sweet) Herbicide Weed Control Ratings

Trade Name	Crop			Annual Broadleaves																		Perennials							Crop Tolerance
	seed corn	sweet corn	field corn	barnyard grass	crabgrass	fall panicum	foxtail, giant	foxtail, green	foxtail, yellow	old witch grass	proso millet	buckwheat, wild	cocklebur	corn spurry	fleabane, Canada	lady's thumb	lamb's-quarters	mustards	nightshades	pigweeds	ragweed, common	ragweed, giant	velvetleaf	bindweed, field	horsetail	milkweed	nutsedge	quackgrass	sow-thistle	thistle, Canada	
AXIOM + atrazine*			✓	9	9	8/9[a]	8	9	9	9	4	9	7	9	?	9	9	9	9	9	9	?	5	2	0	0	7	2	2	0	E
AXIOM + BANVEL II			✓	9	9	8/9[a]	8	9	9	9	4	8	8	8	?	9	9	8	9	9	9	?	8	2	0	0	7	0	2	2	G
AXIOM + MARKSMAN			✓	9	9	8/9[a]	8	9	9	9	4	9	8	9	?	9	9	9	9	9	9	?	8	2	0	0	7	0	2	2	G
BLADEX + atrazine*	✓	✓	✓	7	9	8	7	7	7	9	2	9	7	9	?	9	9	9	9	9	9	?	5	2	0	0	0	2	2	0	E
BLADEX + atrazine* + BANVEL II			✓	7	9	8	7	7	7	9	2	9	8	9	?	9	9	9	9	9	9	?	8	2	0	0	0	2	2	2	E
BLADEX + BANVEL II			✓	7	9	8	7	7	7	9	2	9	8	8	?	9	9	9	9	9	9	?	8	2	0	0	0	0	2	2	E
DUAL II MAGNUM + AFOLAN F + AATREX NINE O		✓		9	9	8/9[a]	8	9	9	9	2	9	7	9	?	9	9	9	9	9	9	?	7	0	0	0	8/9[b]	0	0	0	E
DUAL II MAGNUM + BANVEL II			✓	9	9	8/9[a]	8	9	9	9	4	8	8	8	?	9	9	8	9	9	9	?	8	2	0	0	8/9[b]	0	2	2	G
DUAL II MAGNUM + FIELDSTAR			✓	9	9	8/9[a]	8	9	9	9	4	9	9	?	8	9	9	9	9	9	9	?	9	0	0	0	8/9[b]	0	7	7	E
DUAL II MAGNUM + MARKSMAN			✓	9	9	8/9[a]	8	9	9	9	4	9	8	9	?	9	9	9	9	9	9	?	8	2	0	0	8/9[b]	0	2	2	G
ERADICANE + atrazine*		✓	✓	9	9	8	8	9	9	9	7	9	7	9	?	9	9	9	9	9	9	?	5	2	7	0	8[a]	2[a]	2	2	E
ERADICANE + BLADEX		✓	✓	9	9	8	8	9	9	9	7	8	7	8	?	8	9	9	9	7	8	?	5	2	7	0	8[a]	2[a]	2	2	E
ERADICANE + FIELDSTAR			✓	9	9	8	8	9	9	9	7	9	9	?	8	9	9	9	9	9	9	?	9	2	7	0	8[a]	2[a]	7	7	E
ERADICANE + SENCOR, EVICT			✓	9	9	8	8	9	9	9	7	7	7	8	?	9	9	9	8	9	8	?	8	2	7	0	8[a]	2[a]	2	2	G
FRONTIER + atrazine*		✓	✓	9	9	8/9[a]	8	9	9	9	4	9	7	9	?	9	9	9	9	9	9	?	5	2	0	0	8/9[b]	2	2	0	E
FRONTIER + BANVEL II			✓	9	9	8/9[a]	8	9	9	9	4	8	8	8	?	9	9	8	9	9	9	?	8	2	0	0	8/9[b]	0	2	2	G
FRONTIER + FIELDSTAR			✓	9	9	8/9[a]	8	9	9	9	4	9	9	?	8	9	9	9	9	9	9	?	9	0	0	0	8/9[b]	0	7	7	E
FRONTIER + MARKSMAN			✓	9	9	8/9[a]	8	9	9	9	4	9	8	9	?	9	9	9	9	9	9	?	8	2	0	0	8/9[b]	2	2	2	G
LOROX or LINURON 480 + atrazine*			✓	7	7	7	7	7	7	7	2	9	7	9	?	9	9	9	9	9	9	?	5	2	0	0	0	2	2	0	G
PRIMEXTRA II MAGNUM + AFOLAN, LOROX or LINURON 480			✓	9	9	8/9[a]	8	9	9	9	2	9	7	9	?	9	9	9	9	9	9	?	7	0	0	0	8/9[b]	0	0	0	E

Table 12. Corn (Field and Sweet) Herbicide Weed Control Ratings

Trade Name	Crop			Annual Broadleaves																Perennials							Crop Tolerance
	seed corn	sweet corn	field corn	barnyard grass	crabgrass	fall panicum	foxtail, giant	foxtail, green	foxtail, yellow	old witch grass	proso millet	buckwheat, wild	cocklebur	corn spurry	fleabane, Canada	lady's thumb	lamb's-quarters	mustards	nightshades	pigweeds	ragweed, common	ragweed, giant	velvetleaf	bindweed, field	horsetail	milkweed	nutsedge	quackgrass	sow-thistle	thistle, Canada	
PRIMEXTRA II MAGNUM + BANVEL II			✓	9	9	8/9[a]	8	9	9	9	4	9	8	9	?	9	9	9	9	9	9	?	8	2	0	0	8/9[b]	0	2	2	G
PRIMEXTRA II MAGNUM + FIELDSTAR			✓	9	9	8/9[a]	8	9	9	9	4	9	9	?	8	9	9	9	9	9	9	?	9	2	0	0	8/9[b]	2	7	7	E
PROWL + atrazine *			✓	9	8	9	8	8	8	?	5	9	7	9	?	9	9	9	9	9	9	?	6	2	?	?	?	2	2	?	E
PROWL + BANVEL II			✓	9	8	9	8	8	8	?	5	8	8	8	?	9	9	8	9	9	9	?	8	?	?	?	?	?	?	?	E
PROWL + BLADEX			✓	9	8	9	8	8	8	9	5	9	7	9	?	9	9	9	9	9	9	?	6	2	?	?	?	2	2	?	E
PROWL + FIELDSTAR			✓	9	9	9	8	8	8	9	5	9	9	?	8	9	9	9	9	9	9	?	9	0	0	0	8/9[b]	0	7	7	E
PROWL + MARKSMAN			✓	9	8	9	8	8	8	?	5	9	8	9	?	9	9	9	9	9	9	?	8	?	?	?	?	?	?	?	E
PURSUIT[2] + atrazine			✓[2]	8	9	8	7	7	7	9	7	9	7	9	?	9	9	9	9	9	9	?	9	?	?	?	7	5	?	?	E[2]
PURSUIT[2] + BANVEL II			✓[2]	8	7	7	9	9	9	9	7	8	8	8	?	9	9	9	9	9	9	?	9	2	?	?	7	5	2	2	E[2]
PURSUIT[2] + BLADEX			✓[2]	8	9	8	7	7	7	9	7	9	7	9	?	9	9	9	9	9	9	?	9	?	?	?	7	5	?	?	E[2]
PURSUIT[2] + PROWL			✓[2]	9	8	9	9	9	9	9	7	8	6	?	?	9	9	9	9	9	8	?	9	?	?	?	7	5	?	?	E[2]
DUAL II MAGNUM	✓	✓	✓	9	9	8/9[a]	8	8	8	9	2	0	0	0	0	0	7	0	8	8	0	0	0	0	0	0	0	0	0	0	E
FRONTIER			✓	9	9	8/9[a]	8	8	8	9	2	0	0	0	0	0	0	0	8	8	0	0	0	0	0	0	0	0	0	0	E
ACCENT	✓	✓[3]	✓	9	5	9	9	9	8	9	9	0	0	0	0	0	0	0	0	9	0	0	0	0	0	0	0	9	0	0	E[3]
ELIM EP			✓	9	5	9	9	9	8	9	7	?	?	?	?	5	5	7	2	9	?	?	5	?	?	?	?	?	?	?	G
PROWL																															
ULTIM			✓	9	5	9	9	9	8	9	9	?	?	?	?	5	5	7	2	9	?	?	5	?	?	7	?	9	?	?	G
2,4-D*			✓	0	0	0	0	0	0	0	0	7	8	2	?	7	9	9	7	9	9	?	9	7	0	0	0	0	8	8	G
2,4-DB*			✓	0	0	0	0	0	0	0	0	8	8	0	?	0	7	8	7	9	9	?	9	8	0	0	0	0	8	8	G
atrazine* + LENTAGRAN	✓		✓	7	2	0	7	7	7	7	2	7	?	?	?	7	9	8	9	9	9	?	8	?	?	?	?	?	?	?	E
atrazine* + oil	✓	✓	✓	7	2	0	7	7	7	7	2	9	7	9	?	9	9	9	9	9	9	?	7	7	5	2	5	5	7	2	G
BANVEL II			✓	0	0	0	0	0	0	0	0	9	9	9	9	9	9	7	9	9	9	9	9	8	0	0	0	0	9	8	G
BASAGRAN FORTE	✓	✓	✓	0	0	0	0	0	0	0	0	7	9	9	5	9	8	9	7	8	8	?	9	6	0	0	8	0	6	8	E

Table 12. Corn (Field and Sweet) Herbicide Weed Control Ratings

Trade Name	Crop			Annual Broadleaves																		Perennials							Crop Tolerance
	seed corn	sweet corn	field corn	barnyard grass	crabgrass	fall panicum	foxtail, giant	foxtail, green	foxtail, yellow	old witch grass	proso millet	buckwheat, wild	cocklebur	corn spurry	fleabane, Canada	lady's thumb	lamb's-quarters	mustards	nightshades	pigweeds	ragweed, common	ragweed, giant	velvetleaf	bindweed, field	horsetail	milkweed	nutsedge	quackgrass	sow-thistle	thistle, Canada	
BUCTRIL M, MEXTROL			✓	0	0	0	0	0	0	0	0	9	9	?	?	9	9	9	9	8	9	?	9	7	7	0	0	0	7	7	G
DISTINCT			✓	?	?	?	?	?	?	?	?	9	?	?	?	9	9	?	?	9	9	?	9	?	?	?	?	?	9	9	E
FIELDSTAR			✓	0	0	0	0	0	0	0	0	8	8	?	?	9	9	9	9	9	9	?	9	0	0	0	0	0	7	7	E
KIL-MOR			✓	0	0	0	0	0	0	0	0	9	8	9	9	9	9	9	8	9	9	?	8	9	0	0	0	0	8	8	G
KORIL		✓	✓	0	0	0	0	0	0	0	0	9	8	?	?	9	9	8	9	8	9	?	9	7	0	0	0	0	7	7	E
LADDOK	✓	✓	✓	0	0	0	0	0	0	0	0	9	9	9	?	9	9	9	9	9	9	?	9	7	0	0	8	0	7	7	E
MARKSMAN			✓	7	0	0	7	7	7	7	0	9	9	9	9	9	9	9	9	9	9	?	9	8	0	0	0	0	8	8	E
MCPA *			✓	0	0	0	0	0	0	0	0	2	7	7	?	0	9	9	?	7	9	?	7	7	8	0	0	0	7	7	G
PARDNER	✓	✓	✓	0	0	0	0	0	0	0	0	9	8	?	?	9	9	8	9	8	9	?	9	7	0	0	0	0	7	7	E
PEAKPLUS [1]			✓	0	0	0	0	0	0	0	0	?	9	?	?	9	9	9	?	9	9	9	9	?	?	?	?	?	?	?	E
SHOTGUN			✓	0	0	0	0	0	0	0	0	9	7	?	?	9	9	9	9	9	9	?	9	0	?	0	0	0	?	?	E
SUMMIT			✓	?	?	?	?	?	?	?	?	?	?	?	?	?	9	9	?	9	9	?	9	?	?	?	?	9	?	?	G
STRIKER			✓	0	0	0	0	0	0	0	0	8	8	?	?	7	9	9	7	9	9	?	9	5	7	0	0	0	7	7	E
TROPOTOX PLUS, CLOVITOX PLUS			✓	0	0	0	0	0	0	0	0	8	8	0	?	0	7	8	7	9	9	?	9	8	0	0	0	0	8	8	G
BLADEX	✓	✓	✓	7	9	8	6	6	6	9	5	8	8	?	?	8	9	9	9	7	9	?	8	2	2	0	0	0	2	2	E
PRIMEXTRA II MAGNUM	✓	✓	✓	9	9	8/9*	8	8	8	9	2	9	7	9	?	9	9	9	9	9	9	?	7	0	0	0	3	0	0	0	E
ULTIMAX [1]+ atrazine*			✓	9	5	9	9	9	8	9	9	5	9	?	?	7	9	8	7	9	9	?	9	?	7	?	?	9	?	?	G
LIBERTY 200 SN [4]			✓[4]	9	9	9	9	9	8/9	9	9	8	9	?	7	8/9	9	9	9	9	9	?	8/9	6	6	?	6	6/7	8	7	E[4]
PATRIOT [2]			✓[2]	9	8	9	9	9	9	9	7	9	8	8	4	9	9	9	9	9	8	?	9	0	0	0	7	5	7	0	E[2]
PURSUIT [2]			✓[2]	9	8	8	9	9	9	9	7	8	8	?	3	9	8	9	9	9	8	6	8	?	0	0	?	0	?	0	E[2]
ROUNDUP TRANSORB [5] VANTAGE PLUS [5]			✓[5]	9	9	9	9	9	9	9	9	8	9	8	8	8	9	9	9	9	9	7/8	9	7/8	?	8	8	9	8	9	E[5]
ACCENT + BANVEL II			✓	9	5	9	9	9	7/8	9	9	9	9	9	9	9	9	7	9	9	9	?	9	8	0	0	0	9	9	8	G
ACCENT + DISTINCT			✓	9	5	9	9	9	8	9	9	9	?	?	?	9	9	?	?	9	9	?	9	?	?	?	?	9	9	9	E

Table 12. Corn (Field and Sweet) Herbicide Weed Control Ratings

Trade Name	Crop			Annual Broadleaves																				Perennials							Crop Tolerance
	seed corn	sweet corn	field corn	barnyard grass	crabgrass	fall panicum	foxtail, giant	foxtail, green	foxtail, yellow	old witch grass	proso millet	buckwheat, wild	cocklebur	corn spurry	fleabane, Canada	lady's thumb	lamb's-quarters	mustards	nightshades	pigweeds	ragweed, common	ragweed, giant	velvetleaf	bindweed, field	horsetail	milkweed	nutsedge	quackgrass	sow-thistle	thistle, Canada	
ACCENT + MARKSMAN			✓	9	5	9	9	9	7/8	9	9	9	9	9	9	9	9	9	9	9	9	?	9	8	0	0	0	9	8	8	E
ACCENT + PARDNER			✓	9	5	9	9	9	7/8	9	9	9	8	?	?	9	9	8	9	8	9	?	9	7	0	0	0	9	7	7	E
ACCENT + PEAKPLUS[1], ACCENT ONE PASS[1]			✓	9	5	9	9	9	8	9	9	?	9	?	?	9	9	9	?	9	9	9	9	0	0	0	0	9	0	0	E
ACCENT + SHOTGUN			✓	7	?	9	?	7	7	?	?	9	7	?	?	9	9	9	9	9	9	?	9	0	?	0	0	9	?	?	G
atrazine* + BANVEL II			✓	7	2	0	7	7	7	7	2	9	9	9	9	9	9	9	9	9	9	?	9	8	5	2	5	5	9	8	G
atrazine* + BUCTRIL M, MEXTROL			✓	7	2	0	7	7	7	7	2	9	9	9	7	9	9	9	9	9	9	?	9	7	7	2	5	5	7	7	G
atrazine* + KIL-MOR			✓	7	2	0	7	7	7	7	2	9	8	9	?	9	9	9	8	9	9	?	8	9	5	2	5	5	8	8	G
atrazine* + KORIL		✓	✓	7	2	0	7	7	7	7	2	9	8	9	7	9	9	9	9	9	9	?	9	7	5	2	5	5	7	2	E
atrazine* + PARDNER	✓	✓	✓	7	2	0	7	7	7	7	2	9	8	9	7	9	9	9	9	9	9	?	9	7	5	2	5	5	7	2	E
BANVEL II + 2,4-D*			✓	0	0	0	0	0	0	0	0	9	9	9	9	9	9	9	9	9	9	?	9	8	0	0	0	0	9	8	G
BANVEL II + PARDNER			✓	0	0	0	0	0	0	0	0	9	9	9	9	9	9	8	9	9	9	?	9	8	0	0	0	0	9	8	G
BLADEX + atrazine*	✓	✓	✓	7	9	8	6	6	6	9	5	9	8	9	?	9	9	9	9	9	9	?	8	2	5	2	5	5	7	2	E
BLADEX + atrazine* + BANVEL II			✓	7	9	8	6	6	6	9	5	9	9	9	9	9	9	9	9	9	9	?	9	8	5	2	5	5	9	8	G
BLADEX + BANVEL II			✓	7	9	8	6	6	6	9	5	9	9	9	9	9	9	7	9	9	9	?	9	8	0	0	0	0	9	8	G
DUAL II MAGNUM + BANVEL II			✓	9	9	8/9[a]	8	8	8	9	2	9	9	9	9	9	9	7	9	9	9	?	9	8	0	0	0	0	9	8	G
DUAL II MAGNUM + MARKSMAN			✓	9	9	8/9[a]	8	8	8	9	2	9	9	9	9	9	9	9	9	9	9	?	9	8	0	0	0	0	8	8	E
ELIM EP + BANVEL II			✓	9	5	9	9	9	7	9	7	9	9	9	9	9	9	7	9	9	9	?	9	8	0	0	0	0	9	8	G
ELIM EP + MARKSMAN			✓	9	5	9	9	9	7	9	7	9	9	9	9	9	9	9	9	9	9	?	9	8	0	0	0	0	8	8	E
ELIM EP + PROWL			✓	9	8	9	8	8	8	9	7	?	?	?	?	6	9	0	8	8	2	?	6	?	?	?	?	?	?	?	G
ELIM EP + PROWL + BANVEL II			✓	9	8	9	8	8	8	9	7	8	8	8	9	9	9	8	9	9	9	?	8	?	?	?	?	?	?	?	G
ELIM EP + PROWL + SHOTGUN			✓	9	?	?	?	9	7	?	?	9	7	?	?	9	9	9	9	9	9	?	9	0	?	0	0	0	?	?	G
ELIM EP + SHOTGUN			✓	9	?	9	?	8	7	?	?	9	7	?	?	9	9	9	9	9	9	?	9	0	?	0	0	0	?	?	G
FRONTIER + BANVEL II			✓	9	9	8/9[a]	8	8	8	9	2	9	9	9	9	9	9	7	9	9	9	?	9	8	0	0	0	0	9	8	G

Table 12. Corn (Field and Sweet) Herbicide Weed Control Ratings

Trade Name	Crop			Annual Broadleaves																		Perennials							Crop Tolerance
	seed corn	sweet corn	field corn	barnyard grass	crabgrass	fall panicum	foxtail, giant	foxtail, green	foxtail, yellow	old witch grass	proso millet	buckwheat, wild	cocklebur	corn spurry	fleabane, Canada	lady's thumb	lamb's-quarters	mustards	nightshades	pigweeds	ragweed, common	ragweed, giant	velvetleaf	bindweed, field	horsetail	milkweed	nutsedge	quackgrass	sow-thistle	thistle, Canada	
FRONTIER + BLADEX + atrazine*			✓	9	9	8/9[a]	8	8	8	9	5	9	8	9	?	9	9	9	9	9	9	?	8	2	5	2	0	5	7	2	E
FRONTIER + MARKSMAN			✓	9	9	8/9[a]	8	8	8	9	2	9	9	9	9	9	9	9	9	9	9	?	9	8	0	0	0	0	8	8	E
PRIMEXTRA II MAGNUM + BANVEL II			✓	9	9	8/9[a]	8	8	8	9	2	9	9	9	9	9	9	9	9	9	9	?	9	8	0	0	3	0	8	8	E
PRIMEXTRA II MAGNUM + FIELDSTAR			✓	9	9	8/9[a]	8	8	8	9	2	9	8	9	?	9	9	9	9	9	9	?	9	0	0	0	3	0	7	7	E
PROWL + atrazine *			✓	9	8	9	8	8	8	7	5	9	7	9	?	9	9	9	9	9	9	?	6	2	?	?	?	2	2	?	E
PROWL + BANVEL II			✓	9	8	9	8	8	8	?	5	8	8	8	9	9	9	8	9	9	9	?	8	?	?	?	?	?	?	?	E
PROWL + BLADEX			✓	9	8	9	8	8	8	9	5	9	7	9	?	9	9	9	9	9	9	?	6	2	?	?	?	2	2	?	E
PROWL + MARKSMAN			✓	9	8	9	8	8	8	8	5	9	8	9	9	9	9	9	9	9	9	?	8	?	?	?	?	?	?	?	E
ULTIM + BANVEL II			✓	9	5	9	9	9	8	9	9	9	9	9	9	9	9	7	9	9	9	?	9	8	0	0	0	9	9	8	G
ULTIM + BLADEX			✓	9	5	9	9	9	8	9	9	8	8	?	?	8	9	9	9	7	9	?	8	2	2	0	0	9	2	2	G
ULTIM + DISTINCT			✓	9	5	9	9	9	8	9	9	9	?	?	?	9	9	?	?	9	9	?	9	?	?	?	?	9	9	9	E
ULTIM + MARKSMAN			✓	9	5	9	9	9	8	9	9	9	9	9	9	9	9	9	9	9	9	?	9	8	0	0	0	9	8	8	G
ULTIM + PARDNER			✓	9	5	9	9	9	8	9	9	9	8	?	?	9	9	8	9	8	9	?	9	7	0	0	0	9	7	7	G
ULTIM + PARDNER + atrazine*			✓	9	5	9	9	9	8	9	9	9	8	9	?	9	9	9	9	9	9	?	9	7	5	2	5	9	7	2	G
ULTIM + PEAKPLUS[1]			✓	9	5	9	9	9	8	9	9	?	9	?	?	9	9	9	?	9	9	9	9	?	?	7	?	9	?	?	G
ULTIM + SHOTGUN			✓	8	?	8	?	9	7	?	?	9	7	?	?	9	9	9	9	9	9	?	9	0	?	7	0	9	?	?	G
ULTIM + STRIKER			✓	9	5	9	9	9	8	9	9	8	8	?	?	7	9	9	7	9	9	?	9	5	7	0	0	9	7	7	G
ULTIMAX[1] + atrazine*			✓	9	6	9	9	9	8	9	9	9	8	9	?	9	9	9	9	9	9	?	9	7	7	2	5	9	7	7	G
[redacted]																															
LIBERTY 200 SN[4] + atrazine			✓[4]	9	9	9	9	9	8/9	9	9	8	9	9	7	8/9	9	9	9	9	9	?	8/9	6	6	2	6	6/7	8	7	E[4]
LIBERTY 200 SN[4] + BANVEL II			✓[4]	9	9	9	9	9	8/9	9	9	9	9	9	9	8/9	9	9	9	9	9	?	9	8	?	?	0	6/7	9	8	G[4]
LIBERTY 200 SN[4] + MARKSMAN			✓[4]	9	9	9	9	9	8/9	9	9	9	9	?	9	8/9	9	9	9	9	9	?	9	8	?	?	0	6/7	8	8	E[4]
LIBERTY 200 SN[4] + PROWL			✓[4]	9	9	9	9	9	8/9	9	9	8	9	?	?	8/9	9	9	9	9	9	?	8/9	?	?	?	0	6/7	8	7	E[4]

Table 12. Corn (Field and Sweet) Herbicide Weed Control Ratings

Trade Name	Crop			Annual Broadleaves																		Perennials							Crop Tolerance
	seed corn	sweet corn	field corn	barnyard grass	crabgrass	fall panicum	foxtail, giant	foxtail, green	foxtail, yellow	old witch grass	proso millet	buckwheat, wild	cocklebur	corn spurry	fleabane, Canada	lady's thumb	lamb's-quarters	mustards	nightshades	pigweeds	ragweed, common	ragweed, giant	velvetleaf	bindweed, field	horsetail	milkweed	nutsedge	quackgrass	sow-thistle	thistle, Canada	
LIBERTY PRIME[1]		✓[4]		**9**	**9**	**9**	**9**	**9**	**8/9**	**9**	**9**	**9**	7	**9**	?	**9**	**9**	**9**	**9**	**9**	**9**	?	7	**6**	6	?	6	**6/7**	**8**	**7**	E[4]
PURSUIT[2] + BANVEL II		✓[2]		**9**	8	8	9	**9**	**9**	9	7	**9**	9	**9**	9	**9**	**9**	**7**	9	**9**	**9**	?	**9**	**8**	0	0	0	0	**9**	**8**	E[2]
PURSUIT[2] + MARKSMAN		✓[2]		**9**	8	8	9	**9**	**9**	9	7	**9**	9	**9**	9	**9**	**9**	**9**	9	**9**	**9**	?	**9**	**8**	0	0	0	0	8	**8**	E[2]
PURSUIT[2] + PROWL		✓[2]		**9**	8	8	9	**9**	**9**	9	7	8	6	?	?	9	**9**	9	**9**	**9**	8	?	**9**	?	?	?	7	5	?	?	E[2]
PURSUIT[2] + BLADEX		✓[2]		**9**	**9**	**8**	9	**9**	**9**	**9**	7	**8**	8	?	?	**8**	**9**	9	**9**	**9**	**9**	?	**8**	2	2	0	0	0	2	2	E[2]
Directed postemergence																															
AFOLAN F, LINURON 480, LOROX	✓	✓		**9**	7	**9**	**8**	**8**	**8**	**9**	8	**9**	9	**9**	?	**9**	**9**	**9**	9	**9**	**9**	?	**9**	7	**8**	7	**8**	7	8	7	G
ULTIM		✓		**9**	5	**9**	9	**9**	**9**	**9**	**9**	?	?	?	?	5	5	7	2	**9**	?	?	5	?	?	?	?	**9**	?	?	G
Directed postemergence - herbicide tolerant hybrids only																															
LIBERTY 200 SN[4]		✓[4]		**9**	**9**	**9**	**9**	**9**	**8/9**	**9**	**9**	**8**	**9**	?	7	**8/9**	**9**	**9**	**9**	**9**	**9**	?	**8/9**	?	?	?	0	**6/7**	**8**	**7**	E[4]

* Various formulations available, see Table 1. See label for specific uses and rates.

? Insufficient information available to make a rating

[1] Indicates herbicides sold as a co-pack under this trade name

[2] For use on CLEARFIELD corn (imazethapyr tolerant) only

[3] Use only on selected varieties — see precautions for tolerant varieties on label

[4] For use on glufosinate ammonium (LIBERTY LINK) tolerant corn only.

[5] For use on ROUNDUP READY corn (glyphosate tolerant) only.

[a] Use the high rate of herbicide for optimum control

[b] Use PPI timing for optimum control

[c] Use PRE timing for optimum control

TABLE 13. Corn Soil Applied Herbicide Tank Mixes

common name	Trade Name	grass herbicides					broadleaf herbicides											grass and broadleaf		
		AXIOM	DUAL II MAGNUM	ERADICANE	FRONTIER	PROWL	atrazine*	BANVEL II	BLADEX	FIELDSTAR	MARKSMAN	AFOLAN	LINURON 480	LOROX	EVICT	SENCOR	PRINCEP NINE-T	SIMADEX	SIMAZINE 480	CONVERGE [1]	PRIMEXTRA II MAGNUM	PURSUIT [2]
glyphosate	CREDIT																					
glyphosate	GLYFOS		✓																		✓	
glyphosate	ROUNDUP		✓		✓																✓	
glyphosate	ROUNDUP TRANSORB		✓		✓																✓	
glyphosate	TOUCHDOWN		✓		✓	✓				✓		✓									✓	
glyphosate	VANTAGE																					
glyphosate	VANTAGE PLUS																					
paraquat	GRAMOXONE						✓															
[redacted]																						
flufenacet/metribuzin	AXIOM						✓	✓			✓											
s-metolachlor	DUAL II MAGNUM						✓	✓		✓	✓											
EPTC+	ERADICANE						✓		✓	✓					✓	✓						
dimethenamid	FRONTIER						✓	✓	✓	✓	✓											
pendamethalin	PROWL						✓	✓	✓	✓	✓											✓
[redacted]																						
atrazine	atrazine*	✓	✓	✓	✓	✓		✓	✓				✓	✓								✓
dicamba	BANVEL II	✓	✓		✓	✓	✓		✓												✓	✓
cyanazine	BLADEX			✓	✓	✓	✓	✓														✓
flumetsulam/clopyralid	FIELDSTAR		✓	✓	✓	✓															✓	
dicamba/atrazine	MARKSMAN	✓	✓		✓	✓																
linuron	AFOLAN F																				✓	
linuron	LINURON 480						✓														✓	
linuron	LOROX						✓														✓	
metribuzin	EVICT			✓																		
metribuzin	SENCOR			✓																		
simazine	PRINCEP NINE-T																					
simazine	SIMADEX																					
simazine	SIMAZINE 480																					
[redacted]																						
isoxaflutole/atrazine	CONVERGE [1]																					
s-metolachlor/atrazine	PRIMEXTRA II MAGNUM							✓		✓		✓	✓	✓								
imazethapyr	PURSUIT [2]					✓	✓	✓	✓													

Registered 3-Herbicide Tank mixes

BLADEX + BANVEL II + atrazine
DUAL II MAGNUM + AFOLAN F + AATREX NINE O
DUAL II MAGNUM + BANVEL II + atrazine
DUAL II MAGNUM + SENCOR + atrazine
FRONTIER + BLADEX + ATRAZINE
ROUNDUP + FRONTIER + atrazine
ROUNDUP + FRONTIER + MARKSMAN
ROUNDUP, GLYFOS, TOUCHDOWN + DUAL II MAGNUM + atrazine

Co-Packs

[1] CONVERGE is a co-pack of CONVERGE 75 (isoxaflutole) and CONVERGE 480 (atrazine)

* Various products and formulations available

TABLE 14. Corn Postemergence Herbicide Tank-Mixes

common name	TRADE NAME	grass herbicides						broadleaf herbicides																				grass and broadleaf		herbicide tolerant only		
		ACCENT	DUAL II MAGNUM	ELIM EP	FRONTIER	PROWL	ULTIM	2,4-D*	2,4-DB*	atrazine*	BANVEL II	BASAGRAN FORTE	BLADEX	BUCTRIL M, MEXTROL	CLOVITOX PLUS	DISTINCT	FIELDSTAR	KIL-MOR	KORIL	LADDOK	LENTAGRAN	MARKSMAN	MCPA *	PARDNER	PEAK [1]	PEAKPLUS [1]	SHOTGUN	STRIKER	SUMMIT	TROPOTOX PLUS	ACCENT 1-PASS [1]	PRIMEXTRA II	ULTIMAX [1]	LIBERTY 200 SN [2]	LIBERTYPRIME [1,2]	PATRIOT [2]	PURSUIT [2]
postemergence grass herbicides																																					
nicosulfuron	ACCENT										✓					✓						✓		✓	✓	✓	✓										
s-metolachlor	DUAL II MAGNUM									✓	✓											✓															
rimsulfuron	ELIM EP					✓					✓											✓					✓										
dimethenamid	FRONTIER									✓	✓		✓									✓															
pendimethalin	PROWL			✓						✓	✓		✓									✓												✓		✓	
nicosulfuron/ rimsulfuron	ULTIM										✓		✓			✓						✓		✓	✓	✓	✓	✓									
postemergence broadleaf herbicides																																					
2,4-D	2,4-D*										✓																										
2,4-DB	2,4-DB*																																				
atrazine	atrazine*		✓		✓	✓					✓		✓					✓	✓					✓	✓							✓	✓				
dicamba	BANVEL II	✓	✓	✓	✓	✓	✓	✓		✓			✓											✓	✓							✓		✓		✓	
bentazon	BASAGRAN FORTE																																				
cyanzine	BLADEX				✓	✓	✓				✓																										✓
bromoxynil/MCPA	BUCTRIL M, MEXTROL									✓																											
MCPA/MCPB	CLOVITOX PLUS																																				
dicamba/	DISTINCT	✓					✓																														
flumetsulam/ clopyralid	FIELDSTAR																														✓						
dicamba/ mecoprop/2,4-D	KIL-MOR									✓																											
bromoxynil	KORIL									✓																											
bentazon/ atrazine	LADDOK																																				
pyridate	LENTAGRAN																																				
dicamba/ atrazine	MARKSMAN	✓	✓	✓	✓	✓	✓																												✓		✓
MCPA	MCPA *																																				
bromoxynil	PARDNER	✓					✓			✓	✓														✓												
primisulfuron	PEAK [1]									✓	✓													✓													
primisulfuron + dicamba	PEAKPLUS [1]	✓					✓																														
atrazine/2,4-D	SHOTGUN	✓		✓			✓																														

TABLE 14 Corn Postemergence Herbicide Tank-Mixes

common name	TRADE NAME	grass herbicides						broadleaf herbicides																				grass and broadleaf		
		ACCENT	DUAL II MAGNUM	ELIM EP	FRONTIER	PROWL	ULTIM	2,4-D*	2,4-DB*	atrazine*	BANVEL II	BASAGRAN FORTE	BLADEX	BUCTRIL M, MEXTROL	CLOVITOX PLUS	DISTINCT	FIELDSTAR	KIL-MOR	KORIL	LADDOK	LENTAGRAN	MARKSMAN	MCPA *	PARDNER	PEAK [1]	PEAKPLUS [1]	SHOTGUN	STRIKER	SUMMIT	TROPOTOX PLUS	ACCENT 1-PASS [1]	PRIMEXTRA II	ULTIMAX [1]	herbicide tolerant only LIBERTY 200 SN [2]	LIBERTYPRIME [1,2]	PATRIOT [2]	PURSUIT [2]
flumetsulam/ clopyralid/ 2,4-D	STRIKER					✓																														
prosulfuron/ dicamba	SUMMIT																																			
MCPA/MCPB	TROPOTOX PLUS																																			
nicosulfuron + primisulfuron + dicamba	ACCENT 1-PASS [1]																																			
nicosulfuron/rimsulfuron + flumetsulam/clopyralid/2,4-D	ULTIMAX [1]									✓																										
s-metolachlor/ atrazine	PRIMEXTRA II MAGNUM										✓						✓																			
glufosinate ammonium	LIBERTY 200 SN [2]					✓				✓	✓											✓												✓		
glufosinate ammonium + s-metolachlor/ atrazine	LIBERTYPRIME [1]																																			
imazethapyr/ atrazine	PATRIOT [2]																																			
imazethapyr/ atrazine	PURSUIT [2]					✓					✓		✓									✓														
glyphosate	ROUNDUP [2]																																			
glyphosate	ROUNDUP TRANSORB [2]																																			
glyphosate	VANTAGE [2]																																			
glyphosate	VANTAGE PLUS [2]																																			

Registered 3-Herbicide Tank mixes

ACCENT + PEAKPLUS
BLADEX + BANVEL II + ATRAZINE
ELIM EP + PROWL + BANVEL II
FRONTIER + BLADEX + atrazine
ULTIM + PARDNER + atrazine
ULTIM + PEAKPLUS
ULTIMAX + atrazine

[1] **Co-Packs**

ACCENT 1-PASS is a co-pack of ACCENT and PEAKPLUS
LIBRTYPRIME is a co-pack of LIBERTY and PRIMEXTRA II MAGNUM
PEAKPLUS is a co-pack of PEAK and BANVEL II
ULTIMAX is a co-pack of ULTIM + MAX

* Various products and formulations available

[2] Use only on the appropriate herbicide tolerant hybrids

CHAPTER 10. FORAGE CROPS

Forage Legumes (Direct Seeded)

Soil Applied Treatments include:

- **Preplant (PP)** — Also see Chapter 6, **SPECIAL METHODS: Preplant – Site Preparation** for details of products, rates and remarks.
- **Preplant Incorporated (PPI)** — Two incorporations at right angles operating at a depth of 10 cm using a double disk (7–10 km/hr) or vibrating shank S-tine cultivator (10–13 km/hr) are required unless otherwise stated. Cultivation-type equipment used for herbicide incorporation is known to spread perennial weeds to previously uninfested areas. Special attention should be directed toward machinery cleanliness, and/or treating fields with perennial weeds last.
- **Preemergence (PRE)**
- **Postemergence (POST)** — Leaf stage of the weeds is critical for good weed control. Smaller weeds are usually more sensitive to herbicide injury. Apply according to recommended leaf stages. Crop stage is important to optimize crop safety. Adjuvants will frequently improve the weed control when used as directed. Weather or other conditions may influence the optimum rate of adjuvant, see the product label for more details. Always use appropriate drift management technology.

Apply all treatments in 100–200 L/ha (40–80 L/ac) water except where otherwise noted.

Active Ingredient TRADE NAME (Formulation)	RATE (active) PRODUCT PER HA	RATE PRODUCT PER ACRE	PRECAUTIONS (For more information, see Chapter 4, Notes on Herbicides and Chapter 5, Notes on Adjuvants.)
Soil Applied Grass Herbicides			
EPTC EPTAM (800 g/L)	3.4 kg/ha 4.25 L/ha	 1.7 L/ac	• Apply PPI. • For pure stands of alfalfa or bird's-foot trefoil. • Apply to a dry soil surface and incorporate into the soil immediately. • Some broadleaf weeds such as ragweed, mustards, and pigweeds frequently escape.
trifluralin TREFLAN (480 g/L) RIVAL (500 g/L) BONANZA 400 (400 g/L)	0.6 to 1.148 kg/ha 1.25 to 2.4 L/ha 1.2 to 2.3 L/ha 1.5 to 2.75 L/ha	 0.5 to 0.96 L/ac 0.48 to 0.92 L/ac 0.6 to 1.1 L/ac	• Apply PPI. • For pure stands of alfalfa. • Some activity on broadleaf weeds. • Use lower rate on sandy soils, higher rate for loam to clay soils.
Postemergence Grass Herbicides			
clethodim SELECT (240 g/L) plus surfactant AMIGO	0.03 to 0.09 kg/ha 0.13 to 0.38 L/ha 5 to 10 L/1000 L	 0.05 to 0.15 L/ac	• Apply when the annual grasses and volunteer cereals are in the 2–6 leaf stage. • For pure stands of alfalfa only. • Alfalfa is tolerant at any growth stage. • Use the higher rate for control of quackgrass. • Allow 30 days between application and harvest.
diclofop-methyl HOE-GRASS 284 (284 g/L)	0.71 to 0.796 kg/ha 2.5 to 2.8 L/ha	 1 to 1.12 L/ac	• Use on alfalfa, red or sweet clover when the grass weeds are in the 1–4 leaf stage. • Broadleaf control herbicides must be applied at least 4 days before or after diclofop-methyl. • **Do NOT** feed forages in the year of seeding after treatment with diclofop-methyl.
fluazifop-p-butyl VENTURE L (125 g/L)	0.1 to 0.25 kg/ha 0.8 to 2 L/ha	 0.32 to 0.8 L/ac	• Use the higher rate (2 L/ha (0.8 L/ac)) when quackgrass is present. • Apply at 2–4 leaf stage of annual grasses and at 3–5 leaf stage quackgrass. • VENTURE L may be tank-mixed with 2,4-DB at label rates for control of a broad range of weeds. (Consult 2,4-DB label). • Alfalfa may be fed to livestock 41 days after treatment. • **Do NOT** feed or graze red clover or bird's-foot trefoil in the year of treatment.

Active ingredient TRADE NAME Formulation	RATE (active) PRODUCT PER HA	RATE PRODUCT PER ACRE	PRECAUTIONS (For more information see Chapter 4 Notes on Herbicides and Chapter 5 Notes on Adjuvants)
sethoxydim POAST ULTRA (450 g/L) plus oil concentrate ASSIST or surfactant/solvent MERGE	0.15 to 0.2 kg/ha 0.32 to 0.47 L/ha 2 L/ha 1 L/ha	 0.13 to 0.19 L/ac 0.8 L/ac 0.4 L/ac	▪ Apply POAST ULTRA to emerged annual grasses in the 1–6 leaf stage during active growth while the crop is small enough to permit thorough spray coverage. ▪ Alfalfa is tolerant to POAST ULTRA at any stage of growth. ▪ Use MERGE for conditions or weeds requiring medium to high rates of POAST ULTRA. ▪ Complete control is normally obtained 7–21 days after application. ▪ Allow 70 days between spraying and harvest.
sethoxydim POAST ULTRA (450 g/L) plus surfactant/solvent MERGE	0.5 kg/ha 1.1 L/ha 1 to 2 L/ha	 0.45 L/ac 0.4 to 0.8 L/ac	▪ Apply at the 1–3 leaf stage of actively growing quackgrass. ▪ Thorough preplant tillage will give more uniform quackgrass emergence. ▪ Gives 6–8 weeks control of quackgrass. ▪ Allow 70 days between spraying and harvest.
Postemergence Broadleaf Herbicides			
2,4-DB CALIBER 400 (400 g/L) COBUTOX 600 (600 g/L) EMBUTOX 625 (625 g/L)	1.1 to 1.4 kg/ha 2.75 to 3.5 L/ha 1.8 to 2.3 L/ha 1.75 to 2.25 L/ha	 1.1 to 1.4 L/ac 0.72 to 0.92 L/ac 0.7 to 0.9 L/ac	▪ Apply in at least 150 L/ha (60 L/ac) water, when alfalfa, bird's-foot trefoil or clovers are in the 1–4 leaf stage. ▪ **Do NOT** graze or cut for hay in the year of treatment with CALIBER and COBUTOX and within 30 days of treatment with EMBUTOX ▪ Do **NOT** apply to crops grown for seed. ▪ 2,4-DB usually suppresses legume growth for a period of 2–3 weeks. ▪ Under drought, high temperature or other stress conditions, 2,4-DB may severely injure legumes.
2,4-DB CALIBER 400 (400 g/L) COBUTOX 600 (600 g/L) EMBUTOX 625 (625 g/L) plus MCPA ESTEMINE MCPA (500 g/L)	0.8 kg/ha 2 L/ha 1.3 L/ha 1.25 L/ha 35 g/ha 70 mL/ha	 0.8 L/ac 0.52 L/ac 0.5 L/ac 28 mL/ac	▪ Apply when the legumes are in the 1–4 leaf stage. ▪ **Do NOT** graze or cut for hay in the year of treatment treatment with CALIBER and COBUTOX and within 30 days of treatment with EMBUTOX ▪ Do **NOT** apply to crops grown for seed. ▪ The addition of MCPA gives better control of common mustard than 2,4-DB alone. ▪ Apply in at least 150 L/ha (60 L/ac) water.
bentazon BASAGRAN (480 g/L) plus oil concentrate ASSIST	0.84 to 1.08 kg/ha 1.75 to 2.25 L/ha 1 to 2 L/ha	 0.7 to 0.9 L/ac 0.4 to 0.8 L/ac	▪ Apply after third trifoliate stage of alfalfa ▪ For alfalfa seed production only. ▪ Top growth of nutsedge and Canada thistle are controlled and field bindweed may be suppressed by 2 applications of 1.75 L/ha (0.7 L/ac), 10 days apart. ▪ Cool weather or drought may reduce control. ▪ Reduce rate of oil concentrate to 1 L/ha (0.4 L/ac) under abnormally hot and humid weather conditions or temporary crop injury may occur.

MCPB/MCPA (15:1)
CLOVITOX PLUS (400 g/L)
TROPOTOX PLUS (400 g/L)
	1.1 to 1.7 kg/ha
	2.75 to 4.25 L/ha
	2.75 to 4.25 L/ha
		
		1.1 to 1.7 L/ac
		1.1 to 1.7 L/ac
			▪ Apply when clovers are in the unifoliate to the 4th trifoliate leaf stage.
			▪ Clovers may be suppressed for 2–3 weeks.
			▪ Apply TROPOTOX PLUS in no less than 150 L/ha (60 L/ac) of water.
			▪ For CLOVITOX PLUS:
			  ▪ **Do NOT** apply when temperatures exceed 27 °C or under drought conditions-
			  ▪ **Do NOT** graze or cut for forage in the year of application-
			  ▪ **Do NOT** apply in less than 175 L/ha (70 L/ha) of water.

Forage Legumes (Established)

Postemergence Grass Herbicides

fluazifop-p-butyl VENTURE L (125 g/L)	0.177 to 0.25 kg/ha 0.8 to 2 L/ha	0.32 to 0.8 L/ac	▪ Use the higher rate (2 L/ha (0.8 L/ac)) when quackgrass is present. ▪ Apply at 2–4 leaf stage of annual grasses and at 3–5 leaf stage quackgrass. ▪ VENTURE L may be tank-mixed with 2,4-DB at label rates for control of a broad range of weeds. (Consult 2,4-DB label). ▪ Alfalfa may be fed to livestock 41 days after treatment. ▪ **Do NOT feed red clover or bird's-foot trefoil to livestock in the year of treatment.**
propyzamide KERB (50 WP)	1.125 to 1.625 kg/ha 2.25 to 3.25 kg/ha	0.9 to 1.3 kg/ac	▪ For grass control only in alfalfa and bird's-foot trefoil. ▪ Apply in late September to early November before the soil freezes. ▪ Do not graze or harvest treated forage within 90 days for the high rate and 60 days for lower rates.
quizalofop-p-ethyl ASSURE II (96 g/L) plus oil concentrate CANPLUS 411 SURE-MIX	0.036 to 0.072 kg/ha 0.375 to 0.75 L/ha 5 to 10 L/1000 L 5 L/1000 L	0.15 to 0.3 L/ac	▪ Apply to emerged annual grasses and volunteer cereals in the 2–leaf to tillering stage and to quackgrass in the 2–6 leaf stage of growth. ▪ For seed alfalfa only. ▪ **Do NOT** graze or cut for hay in the year of treatment. ▪ Use the 0.375 L/ha rate (0.15 L/ac) for control of volunteer corn, volunteer cereals and green foxtail. ▪ The 0.5 L/ha (0.2 L/ac) rate provides suppression of quackgrass and will also control barnyard grass. ▪ Use the 0.75 L/ha (0.3 L/ac) rate for control of quackgrass. ▪ Use the higher rate of CANPLUS 411 when wild oats and quackgrass are the target weeds or under drought conditions.
sethoxydim POAST ULTRA (450 g/L) plus surfactant/solvent MERGE	0.5 kg/ha 1.1 L/ha 1 to 2 L/ha	0.45 L/ac 0.4 to 0.8 L/ac	▪ Apply at the 1–3 leaf stage of actively growing quackgrass. ▪ Apply in 110–200 L/ha (44–80 L/ac) water. ▪ Quackgrass control will be provided for 6–8 weeks. ▪ Allow 70 days between spraying and harvest.

Postemergence Broadleaf Herbicides

2,4-DB CALIBER 400 (400 g/L) COBUTOX 600 (600 g/L) EMBUTOX 625 (625 g/L)	1.4 to 1.7 kg/ha 3.5 to 4.25 L/ha 2.3 to 2.8 L/ha 2.25 to 2.75 L/ha	 1.4 to 1.7 L/ac 0.92 to 1.12 L/ac 0.9 to 1.1 L/ac	▪ For pure stands or mixtures containing alfalfa or bird's-foot trefoil apply as spot treatment or when regrowth after cutting or grazing is not more than 7 cm high. ▪ **Do NOT** graze or cut for hay in the year of treatment with Caliber and Cobutox and within 30 days of treatment with Embutox. ▪ Do NOT apply to crops grown for seed. ▪ Apply in at least 150 L/ha (60 L/ac) water.
2,4-DB CALIBER 400 (400 g/L) COBUTOX 600 (600 g/L) EMBUTOX 625 (625 g/L)	1.4 kg/ha 3.5 L/ha 2.3 L/ha 2.25 L/ha	 1.4 L/ac 0.92 L/ac 0.9 L/ac	▪ Apply to actively growing weeds in September or October when regrowth after cutting or grazing is not more than 7 cm high. ▪ Apply in at least 150 L/ha (60 L/ac) water.

Active ingredient TRADE NAME Formulation	RATE (active) PRODUCT PER HA	RATE PRODUCT PER ACRE	PRECAUTIONS For more information see Chapter 4 Notes on Herbicides and Chapter 5 Notes on Adjuvants
MCPB/MCPA (15:1) TROPOTOX PLUS (400 g/L)	1.7kg/ha 4.25 L/ha	 1.7 L/ac	• For pure stands or mixtures containing red and alsike clovers. • Apply as spot treatment, or when regrowth after cutting or grazing is not more than 7 cm high.
Postemergence Grass and Broadleaf Herbicides			
amitrole AMITROL 240 (231 g/L)	3 to 4 kg/ha 12.5 to 16.5 L/ha	 5 to 6.6 L/ac	• Apply after the final harvest in the final year of the forage. • Apply when thistle regrowth is 10–15 cm tall. • Wait 2 weeks before plowing. • **Do NOT** graze or otherwise harvest the forage after spraying.
glyphosate * glyphosate (360 g/L)	1.71 to 4.32 kg/ha 4.75 to 12 L/ha	 1.7 to 4.8 L/ac	• Apply as spot treatment when the field bindweed has reached full bloom and other weeds are in the bud to full bloom stage. • **Do NOT** graze or harvest forage from treated spots until the treated plants turn brown. • **Do NOT** graze or harvest forage from areas treated with TOUCHDOWN.
imazethapyr PURSUIT (240 g/L) plus non-ionic surfactant plus liquid fertilizer (10-34-0, 28-0-0 or 32-0-0)	0.075 to 0.1 kg/ha 0.312 to 0.42 L/ha 0.25 % v/v 2 L/ha	 0.125 to 0.168 L/ac 0.25 % v/v 0.8 L/ac	• Apply only after the crop has one fully developed trifoliate leaf. • For seed alfalfa only. • One application per year. Apply early postemergence when weeds are less than 7.5 cm (3 in.) tall. • Apply in 200 L/ha (80 L/ac) water.
paraquat GRAMOXONE (200 g/L)	0.56 to 1.1 kg/ha 2.8 to 5.5 L/ha	 1.12 to 2.2 L/ac	• Apply to trefoil seed fields when the crop is about 15 cm high in the spring. • Apply to alfalfa or trefoil forage fields within 5 days after cutting. • Slow recovery and some stand reduction has been observed under conditions of drought or high temperatures. • **Do NOT** use in the spring after treatment with simazine.
simazine SIMADEX (500 g/L) PRINCEP NINE-T (90WG) SIMAZINE 80W (80 WP)	1.1 kg/ha 2.2 L/ha 1.22 kg/ha 1.38 kg/ha	 0.88 L/ac 0.49 kg/ac 0.55 kg/ac	• Apply in September to November before freeze up. • This treatment will also prevent legume seedlings from establishing for approximately 8 months. • **Do NOT** use SIMADEX on alfalfa. • **Do NOT** use in the fall before seeding another crop. • **Do NOT** apply GRAMOXONE within 1 yr. after simazine application. • **Do NOT** apply to the same field for more than 3 consecutive yrs. • Allow 30 days between applications and grazing cattle or sheep.
Preharvest			
glyphosate* glyphosate (360 g/L)	0.9 to 1.8 kg/ha 2.5 to 5 L/ha	 1 to 2 L/ac	• Apply 3–7 days prior to last cut in the final year of the forage. Forage can be harvested as hay, haylage or grazed. • **Do NOT** graze or harvest forage from areas treated with TOUCHDOWN.

* Various formulations available see Table 1. See label for specific uses and rates.

Forage Sorghum and Forage Millet

Postemergence Broadleaf Herbicides

prosulfuron + dicamba PEAKPLUS (PEAK (75WG) + BANVEL (480 g/L) plus non-ionic surfactant AGRAL 90, AGSURF or CITOWETT PLUS or plus crop oil concentrate CANPLUS 411 or ASSIST	10 g/ha + 0.14 kg/ha 13.3 g/ha + 0.3 L/ha 2 L/1000 L 10 L/1000 L	 5.3 g/ac + 0.12 L/ac 2 L/1000 L 10 L/1000 L	▪ Available only as a co-pack called PEAKPLUS to be applied with a non-ionic surfactant. ▪ Apply as a broadcast spray. ▪ Apply when the crop is between 3 and 5 leaf–stage. ▪ Best results when applied to actively growing weeds in the 1–6 leaf stage. ▪ **Do NOT** apply by air. ▪ Make only one application per yr.
bentazon BASAGRAN FORTE (480 g/L)	0.84 to 1.08 kg/ha 1.75 to 2.25 L/ha	0.7 to 0.9 L/ac	▪ Apply when crop is at 3–6 leaf stage before closure of canopy. ▪ **Do NOT** apply within 30 days of harvest. ▪ Hot, humid weather may result in temporary leaf yellowing.
bromoxynil PARDNER (280 g/L)	0.28 kg/ha 1 L/ha	0.4 L/ac	▪ Apply post in 200–300 L/ha of water. ▪ Apply when the crop has more than 4 leaves, but before it is 20 cm tall. ▪ Apply ONLY one application per year. ▪ DO NOT harvest within 30 days of application.
2,4-D IPCO 2,4-D Amine 600 (560 g/L)	0.28 to 0.56 kg/ha 0.5 to 1 L/ha	0.2 to 0.4 L/ac	▪ Apply when crop is at 4–6 leaf stage before closure of canopy. ▪ **Do NOT** apply within 30 days of harvest. ▪ **Do NOT** spray in hot (over 27°C) humid weather.

Pasture Renovation with Bird's-foot Trefoil

The introduction of this legume into a pasture requires control of competition from weeds and forage grasses for the first 2–4 months after the legume seed begins to germinate. Control of established perennial weeds should start at least one yr. before the legume seeding operation, using treatments recommended in the previous section of this publication. If the field cannot be plowed and worked to prepare a seedbed, one of the following chemical treatments can be used to suppress the sod.

The success of these programs depends on many management factors such as inoculation of the trefoil seed, and control of fertility and grazing. Consult local agricultural authorities for more information about pasture renovation.

Postemergence Grass and Broadleaf Herbicides

glyphosate * glyphosate (360 g/L)	1.71 to 4.32 kg/ha 4.75 to 12 L/ha	1.9 to 4.8 L/ac	▪ Apply when the forage grasses have at least 2 leaves.
paraquat GRAMOXONE (200 g/L)	1.1 kg/ha 5.5 L/ha	2.2 L/ac	▪ Broadcast seed and fertilizer in mid-April. ▪ Apply GRAMOXONE in early May when the grass is 5 –10 cm high before the legume seed germinates.

* Various formulations available see Table 1. See label for specific uses and rates.

Active ingredient TRADE NAME Formulation	RATE /active PRODUCT PER HA	RATE PRODUCT PER ACRE	PRECAUTIONS For more information see Chapter 4 Notes on Herbicides and Chapter 5 Notes on Adjuvants

Pastures (Mostly Grasses)

Biennials: Most chemicals are best applied in early fall to first year growth or in late spring to second year growth, unless otherwise noted.
Perennials: Apply in late spring (end of May to mid June) when weeds are actively growing unless otherwise noted.

Overgrazing tends to thin the grass stand and allows the establishment of weeds. Undergrazing allows weeds like wild carrot to form and spread seed. Timely mowing can prevent the ripening of weed seeds and reduce the distance these seeds spread with the wind.

Chemicals are available to control most of the troublesome weeds in grass pastures and these can give faster kill of established weeds than any other management practice. A chemical may have to be applied more than once to kill established perennial weeds and the new crop of weeds that emerges through a thin grass stand. A poor grass stand can be improved by using a combination of chemicals, fertility and grazing management.

Chemical weed control should extend into fencerows and other areas around the pasture to keep these areas from becoming sources of weed seeds.

Generally, clovers are severely damaged by chemical treatments. However, white clover and black medic show some resistance or re-establish quickly.

Consult the label in regard to the period of time to keep livestock out of the treated area.

Care should be taken to prevent grazing where poisonous plants (water hemlock, buttercup, chokecherry, etc.) may be made more attractive to livestock after the chemical treatment. It is a good practice to prevent grazing on the field for at least a week after spraying to reduce the chances of the livestock picking up harmful plants.

Apply chemical treatments in at least 200 L/ha (80 L/ac) water and increase this rate if it is necessary to contact weeds through a thick volume of vegetation.

Avoid drift or vapour drift from 2,4-D or dicamba onto susceptible crops by using drift reducing techniques such as high volume, coarse droplets or anti-drift nozzles.

Postemergence Biennial and Perennial Weed Herbicides

2,4-D * 2,4-D (470 g/L)	0.85 kg/ha 1.8 L/ha	0.72 L/ac	▪ **For chicory**.
	0.85 to 1.1 kg/ha 1.8 to 2.34 L/ha	0.72 to 0.94 L/ac	▪ **For yellow rocket**: Mow before spraying if plants are in flowering stage.
	1.01 kg/ha 2.15 L/ha	0.86 L/ac	▪ **For goldenrod**.
	1.1 kg/ha 2.34 L/ha	0.94 L/ac	▪ **Blueweed and burdock**: apply as low volatile ester. ▪ **Wild carrot**: Early spring or early fall. If 2,4-D resistant strains are present, mow to reduce seed spread. ▪ **Goat's-beard**: Early spring or early fall. ▪ **Milkweed**: spray undersides of leaves. Only top growth is killed. ▪ **Water hemlock**: Apply in May or June. ▪ **Dandelion**: Can also apply in September.
	1.1 to 1.75 kg/ha 2.34 to 3.72 L/ha	0.94 to 1.49 L/ac	▪ For **ox-eye daisy** and **hawk's-beard**: Use 2 treatments, one in late spring and the second in early September if there is sufficient growth.
	2.25 kg/ha 4.5 L/ha	1.8 L/ac	▪ For **tansy ragwort**. ▪ Apply to rosettes in spring or fall. ▪ Retreat as necessary to control new seedlings and regrowth.

2,4-D * 2,4-D (470 g/L) plus dicamba BANVEL II (480 g/L)	1.1 kg/ha 2.34 L/ha 1.01 kg/ha 2.1 L/ha	 0.94 L/ac 0.84 L/ac	▪ For **wild carrot**. Apply in early fall for control of first year plants. ▪ Wait 14 days between treatment and harvest or grazing for dairy animals. ▪ Meat animals may graze or feed in treated pastures 30 days after dicamba application without restrictions on slaughter. ▪ If treated vegetation has been consumed by meat animals within 30 days of dicamba application, feed the animals with untreated diet for 30 days before slaughter.
2,4-DB CALIBER 400 (400 g/L) COBUTOX 600 (600 g/L) EMBUTOX 625 (625 g/L)	1.72 kg/ha 4.25 L/ha 2.8 L/ha 2.75 L/ha	 1.7 L/ac 1.12 L/ac 1.1 L/ac	▪ For **nodding, Scotch or bull thistle**. ▪ **Do NOT** graze or cut for hay in the year of treatment.
amitrole AMITROL 240 (231 g/L)	0.038 to 0.106 kg/10 L 0.165 to 0.46 L/10 L		▪ Lower rate for **dandelion, Canada thistle, sow-thistle, hoary cress, milkweed, poison-ivy, and toadflax.** ▪ Higher rate for **horsetail and leafy spurge**. ▪ Use spot treatments. ▪ Spray to wet before flowering. ▪ Keep animals away from treated area for 6–8 months.
dicamba BANVEL II (480 g/L)	0.6 kg/ha 1.25 L/ha	 0.5 L/ac	For all rates: Meat animals may graze or feed treated pastures 30 days after dicamba application without restrictions on slaughter. If treated vegetation has been consumed by meat animals within 30 days of dicamba application, feed the animals with untreated diet for 30 days before slaughter. ▪ For **leafy and cypress spurges**: for control of top growth, apply when weed is actively growing. ▪ No delay is required between treatment and harvest or grazing for dairy animals.
	1.01 kg/ha 2.1 L/ha	 0.84 L/ac	▪ For **tansy ragwort**: apply when weed is actively growing. ▪ Wait 7 days between treatment and harvest or grazing for dairy animals.
	1.1 kg/ha 2.29 L/ha	 0.92 L/ac	▪ For **goldenrod**: apply when weed is actively growing. ▪ Wait 14 days between treatment and harvest or grazing for dairy animals.
	1.2 kg/ha 2.5 L/ha	 1 L/ac	▪ For **Canada thistle and field bindweed**: apply at bud stage of thistle and at flowering of bindweed. ▪ Wait 14 days between treatment and harvest or grazing for dairy animals.
	2.212 kg/ha 4.6 L/ha	 1.84 L/ac	▪ For **goat's beard**: apply when actively growing. ▪ Wait 14 days between treatment and harvest or grazing for dairy animals.
glyphosate* glyphosate (360 g/L)	1.71 to 2.52 kg/ha 4.75 to 7 L/ha	 1.9 to 2.8 L/ac	▪ For **colt's-foot**: apply as spot treatment when colt's-foot leaves are fully expanded. ▪ Wait until the treated areas have turned brown before grazing.
glyphosate* glyphosate (360 g/L)	2.52 to 4.32 kg/ha 7 to 12 L/ha	 2.8 to 4.8 L/ac	▪ For **tansy**: apply as spot treatment when tansy is in bud to full bloom stage.

Active ingredient TRADE NAME Formulation	RATE (active) PRODUCT PER HA	RATE PRODUCT PER ACRE *	PRECAUTIONS (For more information see Chapter 4 Notes on Herbicides and Chapter 5 Notes on Adjuvants)
glyphosate* glyphosate (360 g/L)	1.71 to 4.32 kg/ha 4.75 to 12 L/ha	1.9 to 4.8 L/ac	▪ For **Canada thistle, field bindweed and milkweed**. ▪ Always use high rate for milkweed. ▪ Apply as spot treatment when thistle and milkweed are in the bud to full bloom stage and bindweed is flowering. ▪ Wait until the treated areas have turned brown before grazing. ▪ **Do NOT** graze or harvest forage from areas treated with TOUCHDOWN.
MCPA* MCPA (500 g/L)	1.1 kg/ha 2.2 L/ha	0.88 L/ac	▪ For **buttercup**: use 2 treatments, one in June and the second in early September. ▪ Wait 7 days after treatment before grazing.
MCPB/MCPA CLOVITOX PLUS (400 g/L) TROPOTOX PLUS (400 g/L)	1.7 kg/ha 4.25 L/ha 4.25 L/ha	1.7 L/ac 1.7 L/ac	▪ **Canada thistle**: Apply when 15 cm high to early bud stage. ▪ **Curled dock, plantains**, and sow thistle: Apply to rosette stage. ▪ **Buttercup and field bindweed**: Apply in spring. ▪ **Horsetail**: Apply when 15 cm high. ▪ This treatment has some safety on legumes. ▪ Controls top growth of weeds only. ▪ **Do NOT** apply CLOVITOX PLUS when temperature exceeds 27°C or under drought conditions. ▪ **Do NOT** graze CLOVITOX treated pasture or harvest for forage in year of application. ▪ **Do NOT** apply CLOVITOX PLUS in less than 175 L/ha (70 L/ac) of water. ▪ **Do NOT** apply TROPOTOX PLUS in less than 150 L/ha (60 L/ac) of water.

* Various formulations available see Table 1. See label for specific uses and rates.

Stages of Alfalfa, Red Clover Ladino, Aslike and Black Medic Leaf Development

Unifoliate 1 Trifoliate 2 Trifoliate 3 Trifoliate

Stages of Bird's-Foot Trefoil Leaf Development

1 Trifoliate 2 Trifoliate 3 Trifoliate

Notes:

Weed control ratings are given as 0–9 where 0 indicates no control and 9 indicates 90%–100% control under ideal conditions.

Ratings are subjective values based on best available information and give general comparisons based on use as descibed in this guide.

Under unfavorable conditions (eg., too dry, too wet, too cold, or poor application) the herbicides may not be as effective as indicated.

Ratings may vary with weed and crop stage and with the timing and rates of the product(s) being used.

Ratings in **BOLD** indicate the weed is listed on the product label for control or suppression.

Please see product label for more information on registered weed species, product uses and precautions.

TABLE 15. Forages Herbicide Weed Control Ratings

Trade Name	Crop								Grasses								Annual Broadleaves												Perennials										
	seedling alfalfa	seedling birdsfoot trefoil	seedling clovers	established alfalfa	established birdsfoot trefoil	established clovers	forage grasses and grass pasture	forage sorghum and pearl millet	barnyard grass	crabgrass	fall panicum	foxtail, giant	foxtail, green	foxtail, yellow	old witch grass	wild oats	buckwheat, wild	chickweed,common	cleavers	corn spurry	fleabane, Canada	hempnettle	lady's thumb	lamb's-quarters	mustards	pigweeds	ragweed, common	ragweed, giant	velvetleaf	bindweed, field	chickweed, mouseeared	curled dock	dandelion	horsetail	milkweed	nutsedge	quackgrass	sow-thistle	thistle, Canada
[illegible]																																							
EPTAM	✓	✓							**9**	**9**	**9**	9	**9**	**9**	?	?	6	**7**	?	**?**	0	?	7	**9**	6	**9**	2	0	?	?	?	0	0	0	0	**8**	**2**	0	0
TREFLAN, RIVAL, BONANZA	✓								**9**	**9**	9	9	**9**	**9**	9	**8**	**5**	**?**	?	?	0	5	2	**8**	2	**8**	2	1	3	?	?	0	0	0	0	0	0	0	0
[illegible]																																							
ASSURE II [1]				✓					**9**	8	9	9	**9**	9	9	?	0	0	0	0	0	0	0	0	C	0	0	0	0	0	0	0	0	0	0	**9**	0	0
VENTURE L	✓	✓	✓	✓	✓	✓			**9**	**8**	**9**	**8**	**8**	**8**	**9**	**9**	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**9**	0	0
HOE-GRASS 284	✓		✓						**9**	**8**	**9**	8	**9**	**9**	**9**	?	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0
KERB				✓	✓				**8**	**8**	**6**	?	**8**	**8**	?	?	?	**8**	0	0	0	0	0	0	0	6	0	5	0	0	0	0	0	0	0	**8**	0	0
POAST ULTRA	✓	✓	✓	✓	✓	✓			**9**	**8**	**9**	9	**9**	**9**	**9**	**8**	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**6**	0	0
SELECT	✓								**9**	**8**	**9**	9	**9**	**9**	**9**	?	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	0	0
[illegible]																																							
2,4-D*							✓	✓	0	0	0	0	0	0	0	0	**7**	**8**	?	?	?	?	**7**	**9**	**9**	**9**	**9**	?	**9**	?	?	**7**	**8**	?	0	0	0	**8**	**8**
2,4-DB*, CALIBER, COBUTOX, EMBUTOX [2,3]	✓	✓	✓	✓	✓	✓	✓		0	0	0	0	0	0	0	0	**8**	8	?	?	?	?	**?**	**7**	**8**	**9**	**9**	?	?	**8**	?	**?**	**?**	**?**	?	0	0	8	**8**
BANVEL II							✓		0	0	0	0	0	0	0	0	**8**	?	?	9	8	?	**9**	**9**	7	7	9	8	**9**	**8**	?	?	?	?	2	**8**	0	6	**7**
BASAGRAN	✓			✓				✓	0	0	0	0	0	0	0	0	7	**?**	?	**?**	**5**	?	**9**	**8**	**9**	7	**8**	**6**	**9**	**6**	?	?	?	?	8	?	0	0	6	**5**
MCPA*							✓		0	0	0	0	0	0	0	0	**4**	**?**	?	?	?	**8**	**?**	**9**	**9**	**8**	**8**	?	**8**	**7**	**?**	?	**?**	8	?	0	0	6	**5**

TABLE 15. Forages Herbicide Weed Control Ratings

Trade Name	Crop								Grasses								Annual Broadleaves												Perennials									
	seedling alfalfa	seedling birdsfoot trefoil	seedling clovers	established alfalfa	established birdsfoot trefoil	established clovers	forage grasses and grass pasture	forage sorghum and pearl millet	barnyard grass	crabgrass	fall panicum	foxtail, giant	foxtail, green	foxtail, yellow	old witch grass	wild oats	buckwheat, wild	chickweed,common	cleavers	corn spurry	fleabane, Canada	hempnettle	lady's thumb	lamb's-quarters	mustards	pigweeds	ragweed, common	ragweed, giant	velvetleaf	bindweed, field	chickweed, mouseeared	curled dock	dandelion	horsetail	milkweed	nutsedge	quackgrass	sow-thistle	thistle, Canada
PEAKPLUS								✓	0	0	0	0	0	0	0	0	?	?	?	?	?	?	9	9	9	9	9	9	9	?	?	?	?	?	?	?	?	?	?
TROPOTOX PLUS, CLOVITOX PLUS [4]			✓			✓	✓		0	0	0	0	0	0	0	0	7	2	?	?	?	8	?	9	9	9	8	?	9	8	?	?	?	?	?	0	0	9	9
GRAMOXONE				✓	✓				8	7	9	?	9	9	?	?	9	9	?	?	?	?	9	8	9	9	9	9	?	?	?	0	0	?	0	0	5	0	0
PRINCEP NINE-T, SIMADEX, SIMAZINE [5]				✓	✓	✓			6	8	8	?	?	8	8	9	9	?	?	?	?	?	9	9	9	9	8	?	6	7	?	?	?	?	?	?	6	?	?
PURSUIT [1]	✓[1]			✓					8	7	7	7	9	9	8	8	8	?	?	?	2	?	9	9	9	9	8	6	9	2	?	?	?	2	2	7	5	2	2
2,4-DB* + MCPA * [2,3]	✓								0	0	0	0	0	0	0	0	8	8	?	?	?	?	?	7	9	9	9	?	?	8	?	?	?	?	?	0	0	8	8

* Various formulations available, see Table 1. See label for specific uses and rates.

? Insufficient information available to make a rating

[1] For seed crops only

[2] Do not use on sweet clover

[3] On established legumes, use fall spot treatment only

[4] CLOVITOX PLUS not for established clovers

[5] SIMADEX not for alfalfa

CHAPTER 11. SOYBEANS

All treatments should be applied in 150–300 L/ha (60–120 L/ac) water unless otherwise specified.

Equipment used to apply DICAMBA (BANVEL II), 2,4-D MCPA, MCPB, MCPB/MCPA, 2,4-DB, KIL-MOR, or related herbicides should be thoroughly cleaned up immediately after use as well as before it is used to spray soybeans. See "Cleaning the Sprayer" section.

Total Weed Control System — Although herbicides themselves may be effective, there is benefit in using all the various weed control methods available to obtain the best weed control possible. Crop rotation, herbicide rotation, early weed control with a rotary hoe, harrowing, cultivating and preventing the spread of weeds as much as possible are all a part of weed management. See the corn section for some details of each of these methods.

Triazine Residues – When soybeans follow corn treated with triazines such as atrazine or simazine the previous year, and if triazine residues remain they may interact with a number of herbicides used for weed control in soybeans to cause crop injury. Examples of soybean herbicides, which may be involved, include the triazine based herbicide metribuzin (SENCOR or LEXONE) or the substituted urea herbicides (AFOLAN, AFESIN, LINURON EC, LOROX or PATORAN). The substituted urea herbicides are of less concern in this regard. The potential for injury is greater during adverse weather conditions, in shorter season soybean growing areas and/or in soils with a high pH. Herbicide injury symptoms should not be confused with cold injury symptoms. Also see **"Notes on Atrazine and Simazine Soil Residues"** which appears at the start of the corn section in this publication.

Resistant Weeds – Biotypes of a number of weeds have been found resistant to Group 5 (triazine) and Group 2 herbicides. Refer to the section **"Managing Weed Resistance to Herbicides"** for management and control strategies for these weeds.

Specific Weeds – For information on specific weeds see the **Soybean Herbicide Weed Control Ratings Table**. Then refer to the appropriate section for details about herbicide treatments.

Soil Applied Treatments include:

- **Preplant (PP)** — See Chapter 6 **SPECIAL METHODS: Preplant – Site Preparation** for details of products, rates and remarks.
- **Preplant Incorporated (PPI)** — Two incorporations at right angles operating at a depth of 10 cm using a double disk (7–10 km/hr) or vibrating shank S-tine cultivator (10–13 km/hr) are required unless otherwise stated. Cultivation–type equipment used for herbicide incorporation is known to spread perennial weeds to previously uninfested areas. Special attention should be directed toward machinery cleanliness, and/or treating fields with perennial weeds last.
- **Preemergence (PRE)** — Rainfall of 15–20 mm within 10 days after application is necessary to activate preemergence treatments. Shallow cultivation, rotary hoeing or harrowing will control weed escapes and improves herbicide activity in the absence of rainfall.

Postemergence (POST) — Leaf stage of the weeds is critical for good weed control. Smaller weeds are usually more sensitive to herbicide injury. Apply according to recommended leaf stages. Crop stage is important to optimize crop safety. Adjuvants will frequently improve the weed control when used as directed. Weather or other conditions may influence the optimum rate of adjuvant, see the product label for more details. Always use appropriate drift management technology.

Active Ingredient TRADE NAME (Formulation)	RATE (active) PRODUCT PER HA	RATE PRODUCT PER ACRE	PRECAUTIONS (For more information see Chapter 4 Notes on Herbicides and Chapter 5 Notes on Adjuvants)
Soil Applied Grass Herbicides			
dimethenamid FRONTIER (900 g/L)	1 to 1.25 kg/ha 1.1 to 1.4 L/ha	0.44 to 0.56 L/ac	• Apply preplant or preplant incorporated with the incorporation equipment set no deeper than 10 cm or preemergence. • Use higher rate of FRONTIER for the control of nightshade and pigweed (PPI or PRE only). • Control of nutsedge is achieved by applying FRONTIER preplant incorporated. • Minimum rate for preplant incorporated treatments is 0.5 L/ac.

Active Ingredient TRADE NAME (Formulation)	RATE (active) PRODUCT PER HA	RATE PRODUCT PER ACRE	PRECAUTIONS (For more information, see Chapter 4 Notes on Herbicides and Chapter 5 Notes on Adjuvants)
flufenacet/ metribuzin AXIOM (68 DF)	0.57 to 1 kg/ha 0.84 to 1.47 kg/ha	0.34 to 0.59 kg/ac	▪ Apply PRE. ▪ Plant soybeans at least 4 cm deep. ▪ **Do NOT** apply to coarse textured soils with less than 2% OM. ▪ **Do NOT** use on metribuzin sensitive varieties. See "Ontario Soybean Variety Trials" brochure.
s-metolachlor DUAL MAGNUM (915 g/L)	1.05 to 1.6 kg/ha 1.15 to 1.75 L/ha	0.46 to 0.7 L/ac	▪ Apply PP, PPI or PRE. ▪ Control of yellow nutsedge is obtained when DUAL MAGNUM is applied PPI. ▪ Optimal control of nightshade is obtained when DUAL MAGNUM is applied PRE. ▪ **Do NOT** use on muck, peat or high organic matter soils. ▪ Use the higher rate of (DUAL MAGNUM) for heavier weed populations. ▪ Incorporation depth should not exceed 10 cm.
trifluralin TREFLAN (480 g/L) RIVAL (500 g/L) BONANZA 400 (400 g/L)	0.6 to 1.155 kg/ha 1.25 to 2.4 L/ha 1.2 to 2.3 L/ha 1.5 to 2.75 L/ha	 0.5 to 0.96 L/ac 0.48 to 0.92 L/ac 0.6 to 1.1 L/ac	▪ Apply PPI. ▪ The first incorporation should be done as soon as possible after application but may be delayed up to 8–24 hr. The second incorporation is recommended anytime before planting.
Soil Applied Broadleaf Herbicides			
cloransulam-methyl FIRSTRATE	35 g/ha 41.7 g/ha	17 g/ac	▪ Apply PRE. ▪ Apply in both conventional and conservation tillage systems. ▪ Some rotational cropping restrictions apply (see Table 2).
linuron AFOLAN F (480 g/L) or linuron LOROX DF (50 DF) LINURON 480 (480 g/L)	0.86 to 2.25 kg/ha 1.79 to 4.68 L/ha 1.13 to 2.25 kg/ha 2.26 to 4.5 kg/ha 2.25 to 4.5 L/ha	 0.72 to 1.87 L/ac 0.9 to 1.8 kg/ac 0.9 to 1.8 L/ac	▪ Apply PRE. ▪ **Do NOT** use on sands (less than 2%–3% organic matter, ▪ Plant soybeans at least 4 cm deep. ▪ Heavy rainfall and adverse weather conditions may result in temporary crop injury. ▪ Use higher rate for muck soils and clay soils. ▪ Lorox DF can be applied as preplant tank-mixes at a reduced rate (0.68–0.8 kg/ha). (See soil applied tank-mix options).
metobromuron PATORAN FL (400 g/L)	1 to 2.25 kg/ha 2.50 to 5.63 L/ha	1 to 2.25 L/ac	▪ Apply PRE. ▪ **Do NOT** use on sands (less than 2%–3% organic matter). ▪ Seed beans at least 4 cm deep. ▪ Heavy rainfall and adverse weather conditions may result in temporary crop injury. ▪ Use higher rate for muck soils and clay soils.
metribuzin LEXONE DF (75 DF) SENCOR 75 DF (75 WG) EVICT SOLUPAK (75 WG)	0.56 to 1.12 kg/ha 0.75 to 1.5 kg/ha 0.75 to 1.5 kg/ha 0.75 to 1.5 kg/ac	 0.3 to 0.6 kg/ac 0.3 to 0.6 kg/ac 0.3 to 0.6 kg/ac	▪ Apply PP, PPI or PRE. ▪ **Do NOT** use on metribuzin sensitive varieties. See "Ontario Soybean Variety Trials" brochure. ▪ **Do NOT** use on sandy or coarse soils with less than 2% organic matter. ▪ Use the recommended rate for each soil types (see label), otherwise crop injury may occur. ▪ Excessive rainfall and adverse weather conditions may result in crop injury. ▪ Plant soybeans at least 4 cm deep. ▪ For preplant applications: ▪ Apply up to 30 days prior to seeding the crop.

			• Use the higher rate when weeds are dense and are on soils with high organic matter (over 4%) and on soils with high clay content. • If emerged weeds are taller than 4 cm, apply in tank-mix with glyphosate. • Some rotational cropping restrictions apply (see Table 2).
monolinuron AFESIN (200 g/L)	1.7 to 1.95 kg/ha 8.5 to 9.75 L/ha	3.4 to 3.9 L/ac	• Apply PRE. • **Do NOT** use on sandy soils (3% organic matter or less). • Heavy rainfall and adverse weather conditions may result in crop injury, which is usually of a temporary nature. • Plant soybeans at least 4 cm deep.
Soil Applied Grass and Broadleaf Herbicides			
flumetsulam/metolachlor BROADSTRIKE DUAL (923 g/L)	2.215 kg/ha 2.4 L/ha	0.96 L/ac	• Apply PP, PPI or PRE. For PPI treatments uniformly incorporate with equipment set to work at a depth of 5–8 cm. • For PP treatments in minimum or no-till systems apply up to 21 days before planting. • **Do NOT** apply to areas where the soil pH is >7.8 and organic matter < 2%. • **Do NOT** apply to soils containing more than 5% organic matter. • Sufficient rainfall to moisten the soil to a depth of 5 cm should be received within 7–10 days for optimum weed control. • Suspension concentrate formulation separates into 2 phases over time. Shake container before using. • Some rotational cropping restrictions apply (see Table 2).
flumetsulam/metolachlor BROADSTRIKE DUAL MAGNUM (924.7 g/L)	2.215 kg/ha 1.56 L/ha	0.624 L/ac	• Apply PP, PPI or PRE. For PPI treatments uniformly incorporate with equipment set to work at a depth of 5–8 cm. • For PP treatments in minimum or no-till systems apply up to 21 days before planting. • **Do NOT** apply to areas where the soil pH is >7.8 and organic matter < 2%. • **Do NOT** apply to soils containing more than 5% organic matter. • Sufficient rainfall to moisten the soil to a depth of 5 cm should be received within 7–10 days for optimum weed control. • Suspension concentrate formulation separates into 2 phases over time. Shake container before using. • Some rotational cropping restrictions apply (see Table 2).
flumetsulam/trifluralin BROADSTRIKE TREFLAN (438 g/L)	1.022 kg/ha 2.33 L/ha	0.93 L/ac	• Apply PPI. Must be incorporated within 24 hr. after application. Uniformly incorporate with equipment set to work at a depth of 5 to 8 cm. • For heavy weed infestations or coarse textured soils a second incorporation is recommended. • **Do NOT** apply to natto soybean varieties. • **Do NOT** apply to areas where the soil pH is > 7.8 and organic matter < 2%. • **Do NOT** apply to soils containing more than 5% organic matter. • Suspension concentrate formulation separates into 2 phases over time. Shake container before using. • Some rotational cropping restrictions apply (see Table 2).

Active Ingredient TRADE NAME (Formulation)	RATE (active) PRODUCT PER HA	RATE PRODUCT PER ACRE	PRECAUTIONS For more information see Chapter 4 Notes on Herbicides and Chapter 5 Notes on Adjuvants

imazethapyr
PURSUIT (240 g/L)
	0.075 to 0.1 kg/ha
	0.312 to 0.42 L/ha
		
		0.125 to 0.168 L/ac
			• Apply PP, PPI or PRE.
			• Some rotational cropping restrictions apply (see Table 2).
			• Addition of non-ionic surfactant and liquid fertilizer is required if emerged weeds are present at application.
			• For preplant applications:
			  ▪ apply Pursuit at 0.168 L/ac;
			  ▪ apply up to 30 days prior to planting;
			  ▪ For minimum tillage, only 1 working of the soil to prepare a seedbed is recommended following application. This final seedbed preparation should not be deeper than 10 cm and should not turn untreated soil to the surface.
			• For preplant incorporated applications apply Pursuit at 0.125L/ac.
			• For preemergence applications, heavy infestations of, ragweed and/or barnyard grass require a tank-mix.
			• For preplant incorporated applications heavy infestations of lamb's-quarters, ragweed or barnyard grass may require a tank-mix.
			• **Do NOT** apply as preplant incorporated application more than 1 year in sequence.
			• Use only once per season.

imazethapyr + metribuzin CONQUEST [1] (CONQUEST B(70SG) + CONQUEST A(75WG))	0.075 + 0.425 kg/ha 0.107 kg/ha + 0.567 kg/ha	 0.043 kg/ac + 0.23 kg/ac	• Apply PPI or PRE. • CONQUEST is only available in a package containing both imazethapyr and metribuzin. • For use on medium and heavy textured soils only. • See Pursuit for additional comments. • **Do NOT** use on metribuzin sensitive varieties. See "Ontario Soybean Variety Trials" brochure.
s-metolachlor + metribuzin BOUNDARY [1] (DUAL MAGNUM + SENCOR 500F)	1.05 to 1.60 kg/ha + 0.43 to 0.658 kg/ha 1.15 to 1.75 L/ha + 0.856 to 1.316 L/ha	 0.46 to 0.7 L/ac + 0.34 to 0.53 L/ac	• Apply PP, PPI or PRE. • Under preplant uses, a tank-mixture with glyphosate may be used to control emerged weeds. • Do not apply to coarse textured soils with less than 2% OM. Do not apply use on metribuzin sensitive varieties.
imazethapyr/pendimethalin VALOR ((1:14.5)342 g/L)	1.165 kg/ha 3.4 L/ha	 1.36 L/ac	• Apply PPI. • Allow 24 months between applications. • See Pursuit for additional comments. • Refer to Table 2 for rotation restrictions.
Soil Applied Tank-mix Options			
dimethenamid FRONTIER (900 g/L) plus glyphosate ROUNDUP (356 g/L) or plus glyphosate TMS TOUCHDOWN	1 to 1.25 kg/ha 1.1 to 1.4 L/ha 0.89 kg/ha 2.5 L/ha 0.825 kg/ha 2.5 L/ac	 0.44 to 0.56 L/ac 1 L/ac 1 L/ac	• Apply PP.

dimethenamid FRONTIER (900 g/L) plus imazethapyr PURSUIT (240 g/L)	1 to 1.25 kg/ha 1.1 to 1.4 L/ha 0.075 to 0.1 kg/ha 0.312 to 0.42 L/ha	 0.44 to 0.56 L/ac 0.125 to 0.168 L/ac	▪ Apply PRE.
dimethenamid FRONTIER (900 g/L) plus linuron LOROX DF (50 DF) AFOLAN F (480 g/L)	1 to 1.25 kg/ha 1.11 to 1.4 L/ha 0.91 to 1.15 kg/ha 1.9 to 2.3 kg/ha 1.9 to 2.3 L/ha	 0.44 to 0.56 L/ac 0.76 to 0.92 kg/ac 0.76 to 0.92 L/ac	▪ Apply PRE.
dimethenamid FRONTIER (900 g/L) plus metribuzin LEXONE DF (75 DF) or plus metribuzin SENCOR 75 DF (75 WG) EVICT SOLUPAK (75 WG)	1.125 to 1.25 kg/ha 1.25 to 1.4 L/ha 0.413 to 0.48 kg/ha 0.54 to 0.64 kg/ha 0.4 to 0.502 kg/ha 0.55 to 0.75 kg/ha 0.55 to 0.75 kg/ha	 0.5 to 0.56 L/ac 0.22 to 0.26 kg/ac 0.22 to 0.3 kg/ac 0.22 to 0.3 kg/ac	▪ Apply PPI.
dimethenamid FRONTIER (900 g/L) plus metribuzin LEXONE DF (75 DF) SENCOR 75 DF (75 WG) EVICT SOLUPAK (75 WG)	1 to 1.25 kg/ha 1.1 to 1.4 L/ha 0.41 to 0.566 kg/ha 0.54 to 0.75 kg/ha 0.54 to 0.75 kg/ha 0.54 to 0.75 kg/ha	 0.44 to 0.56 L/ac 0.22 to 0.3 kg/ac 0.22 to 0.3 kg/ac 0.22 to 0.3 kg/ac	▪ Apply PRE.
dimethenamid FRONTIER (900 g/L) plus metribuzin LEXONE DF (75 DF) SENCOR 75 DF (75 WG) EVICT SOLUPAK (75 WG) plus linuron LOROX DF (50 DF) AFOLAN F (480 g/L)	1 to 1.25 kg/ha 1.1 to 1.4 L/ha 0.36 to 0.56 kg/ha 0.48 to 0.75 kg/ha 0.48 to 0.75 kg/ha 0.48 to 0.75 kg/ha 0.7 to 1 kg/ha 1.4 to 2 kg/ha 1.5 to 2.1 L/ha	 0.44 to 0.56 L/ac 0.19 to 0.3 kg/ac 0.19 to 0.3 kg/ac 0.19 to 0.3 kg/ac 0.56 to 0.8 kg/ac 0.6 to 0.84 L/ac	▪ Apply PRE.
flufenacet/metribuzin AXIOM plus imazethapyr PURSUIT	0.57 to 0.85 kg/ha 0.84 to 1.26 kg/ha 0.075 kg/ha 0.310 L/ha	 0.34 to 0.5 kg/ac 0.125 L/ac	▪ Apply PRE. ▪ Plant soybeans at least 4 cm deep. ▪ Some rotational cropping restrictions apply (see Table 2). ▪ **Do NOT** apply to coarse textured soils with less than 2% OM. ▪ **Do NOT** use on metribuzin sensitive varieties. See "Ontario Soybean Variety Trials" brochure.

Active ingredient TRADE NAME Formulation	RATE (active) PRODUCT PER HA	RATE PRODUCT PER ACRE	PRECAUTIONS For more information see Chapter 1 Notes on Herbicides and Chapter 5 Notes on A...
flufenacet/ metribuzin	0.57 to 0.86 kg/ha		▪ Apply PRE.
AXIOM (68 DF)	0.84 to 1.26 kg/ha	0.34 to 0.5 kg/ac	▪ Plant soybeans at least 4 cm deep.
plus linuron	0.85 to 1.15 kg/ha		▪ **Do NOT** apply to coarse textured soils with less than 2% OM.
LOROX DF (50 DF)	1.7 to 2.3 kg/ha	0.68 to 0.92 kg/ac	▪ **Do NOT** use on metribuzin sensitive varieties. See "Ontario Soybean Variety Trials" brochure.
flufenacet/ metribuzin	0.57 to 0.86 kg/ha		▪ Apply PRE.
AXIOM (68 DF)	0.84 to 1.26 kg/ha	0.34 to 0.5 kg/ac	▪ Plant soybeans at least 4 cm deep.
plus metribuzin	0.375 to 0.62 kg/ha		▪ **Do NOT** apply to coarse textured soils with less than 2% OM.
SENCOR 75 DF (75 WG)	0.5 to 0.83 kg/ha	0.2 to 0.33 kg/ac	▪ **Do NOT** use on metribuzin sensitive varieties. See "Ontario Soybean Variety Trials" brochure.
flufenacet/ metribuzin	0.57 to 0.86 kg/ha		▪ Apply PRE.
AXIOM (68 DF)	0.84 to 1.26 kg/ha	0.34 to 0.5 kg/ac	▪ Plant soybeans at least 4 cm deep.
plus metribuzin	0.375 to 0.49 kg/ha		▪ **Do NOT** apply to coarse textured soils with less than 2% OM.
SENCOR 75 DF (75 WG)	0.5 to 0.65 kg/ha	0.2 to 0.26 kg/ac	▪ **Do NOT** use on metribuzin sensitive varieties. See "Ontario Soybean Variety Trials" brochure.
plus linuron	0.7 to 1 kg/ha		
LOROX DF (50 DF)	1.4 to 2 kg/ha	0.56 to 0.8 kg/ac	
flumetsulam/metolachlor	2.2 kg/ha		▪ Apply PRE.
BROADSTRIKE DUAL (923 g/L)	2.4 L/ha	0.96 L/ac	
plus cloransulam-methyl	17.5 g/ha		
FIRST RATE	20.8 g/ha	8.5 g/ac	
Flumetsulam/ metolachlor	2.22 kg/ha		▪ Apply PP.
BROADSTRIKE DUAL (923 g/L)	2.4 L/ha	0.96 L/ac	
plus glyphosate	0.89 kg/ha		
ROUNDUP (360 g/L)	2.5 L/ha	1 L/ac	
VANTAGE (360 g/L	2.5 L/ha	1 L/ac	
or glyphosate TMS	0.83 kg/ha		
TOUCHDOWN 480 (330 g/L)	2.5 L/ha	1 L/ac	
Flumetsulam	2.22 kg/ha		▪ Apply PP.
/s-metolachlor	1.56 L/ha	0.624 L/ac	
BROADSTRIKE DUAL MAGNUM (924.7 g/L)			
plus glyphosate	0.89 kg/ha		
ROUNDUP (360 g/L)	2.5 L/ha	1 L/ac	
VANTAGE (360 g/L	2.5 L/ha	1 L/ac	

flumetsulam/metolachlor	1.7 to 2.215 kg/ha		▪ Apply PRE. ▪ Within the applicable rate range, use the higher rate of SENCOR and BROADSTRIKE DUAL under heavy plant residues on soil surface, or heavy weed pressures, or soil of more than 4% organic matter.
BROADSTRIKE DUAL (923 g/L)	1.85 to 2.4 L/ha	0.74 to 0.96 L/ac	
plus metribuzin	0.3 to 0.5 kg/ha		
SENCOR 75 DF (75WG)	0.4 to 0.67 kg/ha	0.16 to 0.27 kg/ac	
EVICT SOLUPAK (75 WG)	0.4 to 0.67 kg/ha	0.16 to 0.27 kg/ac	
imazethapyr	75 g/ha		▪ Apply PRE.
PURSUIT	0.312 L/ha	0.125 L/ac	
plus cloransulam-methyl	17.5 g/ha		
FIRST RATE	20.8 g/ha	8.5 g/ac	
imazethapyr	0.1 kg/ha		▪ Apply PP.
PURSUIT (240 g/L)	0.42 L/ha	0.168 L/ac	
plus glyphosate	0.836 to 0.89 kg/ha		
CREDIT (360 g/L	2.35 to 2.5 L/ha	0.94 to 1 L/ac	
GLYPHOS (360 g/L)	2.35 to 2.5 L/ha	0.94 to 1 L/ac	
ROUNDUP (360 g/L)	2.35 to 2.5 L/ha	0.94 to 1 L/ac	
VANTAGE (360 g/L)	2.35 to 2.5 L/ha	0.94 to 1 L/ac	
or plus glyphosate TMS	0.825 kg/ha		
TOUCHDOWN 480 (330 g/L)	2.5 L/ha	1 L/ac	
imazethapyr	0.075 to 0.1 kg/ha		▪ Apply PRE.
PURSUIT (240 g/L)	0.312 to 0.42 L/ha	0.125 to 0.168 L/ac	
plus linuron	0.85 to 1.15 kg/ha		
LOROX DF (50 DF)	1.7 to 2.3 kg/ha	0.68 to 0.92 kg/ac	
AFOLAN F (480 g/L)	1.77 to 2.39 L/ha	0.71 to 0.96 L/ac	
LINURON 480 (480 g/L)	1.77 to 2.39 L/ha	0.71 to 0.96 L/ac	
imazethapyr	0.075 to 0.1 kg/ha		▪ Apply PPI or PRE. ▪ Glyphosate (1.25–2.5 L/ha (0.5–1 L/ac) is required to control weeds that are taller than 4 cm and to control weeds that are inherently tolerant to the other herbicides used in these treatments. ▪ For preplant applications the maximum Sencor rate is 1.3 kg/ha.
PURSUIT (240 g/L)	0.31 to 0.42 L/ha	0.125 to 0.168 L/ac	
plus metribuzin	0.41 to 0.48 kg/ha		
LEXONE DF (75 DF)	0.54 to 0.64 kg/ha	0.21 to 0.26 kg/ac	
or plus metribuzin	0.4 to 1.13 kg/ha		
SENCOR 75 DF (75 WG)	0.53 to 1.5 kg/ha	0.21 to 0.6 kg/ac	
EVICT SOLUPAK (75 WG)	0.53 to 1.5 kg/ha	0.21 to 0.6 kg/ac	
imazethapyr	0.1 kg/ha		▪ Apply PP. ▪ See GRAMOXONE instructions in the **"Special Methods – Preplant Site Preparation"** section for details.
PURSUIT (240 g/L)	0.42 L/ha	0.168 L/ac	
plus paraquat	0.55 to 1.1 kg/ha		
GRAMOXONE (200 g/L)	2.75 to 5.5 L/ha	1.1 to 2.2 L/ac	

Active Ingredient TRADE NAME (Formulation)	RATE (active) PRODUCT PER HA	RATE PRODUCT PER ACRE	PRECAUTIONS (For more information see Chapter 4 Notes on Herbicides and Chapter 5 Notes on Adjuvants)
s-metolachlor	1.05 to 1.60 kg/ha		• Apply PRE.
DUAL MAGNUM (915 g/L)	1.15 to 1.75 L/ha	0.46 to 0.7 L/ac	
plus metribuzin	0.16 to 0.41 kg/ha		
LEXONE DF (75 DF)	0.21 to 0.55 kg/ha	0.08 to 0.22 kg/ac	
or metribuzin	0.35 to 0.5 kg/ha		
SENCOR 75 DF (75 WG)	0.47 to 0.67 kg/ha	0.19 to 0.27 kg/ac	
plus linuron	0.7 to 1 kg/ha		
LOROX DF (50 DF)	1.4 to 2 kg/ha	0.56 to 0.8 kg/ac	
AFOLAN F (480 g/L)	1.5 to 2.08 L/ha	0.6 to 0.83 L/ac	
LINURON 480 (480 g/L)	1.5 to 2.08 L/ha	0.6 to 0.83 L/ac	
metribuzin	0.42 to 0.55 kg/ha		• Apply PP.
SENCOR 75 DF (75 WG)	0.56 to 0.73 kg/ha	0.22 to 0.29 kg/ac	
LEXONE DF (75 DF)	0.56 to 0.73 kg/ha	0.22 to 0.29 kg/ac	
EVICT SOLUPAK (75 WG)	0.56 to 0.73 kg/ha	0.22 to 0.29 kg/ac	
plus linuron			
LOROX DF (50 DF)	0.85 to 1 kg/ha		
	1.7 to 2 kg/ha	0.68 to 0.8 kg/ac	
metribuzin	0.56 to 1.12 kg/ha		• Apply PRE but no later than 3 days prior to crop emergence. • See GRAMOXONE application instructions in the **"Preplant Site Preparation"** section.
SENCOR 75 DF (75 WG)	0.75 to 1.5 kg/ha	0.3 to 0.6 kg/ac	
LEXONE DF (75 DF)	0.75 to 1.5 kg/ha	0.3 to 0.6 kg/ac	
EVICT SOLUPAK (75 WG)	0.75 to 1.5 kg/ha	0.3 to 0.6 kg/ac	
plus paraquat	0.5 kg/ha		
GRAMOXONE (200 g/L)	2.5 L/ha	1 L/ac	
metribuzin	0.56 to 1.12 kg/ha		• Apply PP up to 30 days before planting or preemergence to the crop.
SENCOR 75 DF (75 WG)	0.75 to 1.5 kg/ha	0.3 to 0.6 kg/ac	
plus glyphosate TMS	0.41 to 0.825 kg/ha		
TOUCHDOWN 480 (330 g/L)	1.25 to 2.5 L/ha	0.5 to 1 L/ac	
metribuzin	0.33 to 0.75 kg/ha		• Apply PRE.
SENCOR 75 DF (75 WG)	0.44 to 1 kg/ha	0.18 to 0.4 kg/ac	
plus linuron	0.5 to 1.2 kg/ha		
AFOLAN F (480 g/L)	1.04 to 2.5 L/ha	0.42 to 1 L/ac	
LOROX DF (50 DF)	1 to 2.4 kg/ha	0.4 to 0.96 kg/ac	
LINURON 480 (480 g/L)	1.04 to 2.5 L/ha	0.42 to 1 L/ac	
s-metolachlor	1.05 to 1.6 kg/ha		• Apply prior to crop emergence.
DUAL MAGNUM (915 g/L)	1.15 to 1.75 L/ha	0.46 to 0.7 L/ac	
plus glyphosate	0.836 to 0.89 kg/ha		
ROUNDUP (360 g/L)	2.35 to 2.5 L/ha	0.94 to 1 L/ac	
GLYPHOS (360 g/L)	2.35 to 2.5 L/ha	0.94 to 1 L/ac	
or plus glyphosate TMS	0.825 kg/ha		
TOUCHDOWN 480 (330 g/L)	2.5 L/ha	1 L/ac	

s-metolachlor	1.05 to 1.6 kg/ha		▪ Apply prior to crop emergence.
DUAL MAGNUM (915 g/L)	1.15 to 1.75 L/ha	0.46 to 0.7 L/ac	
plus metribuzin	0.5 to 1.09 kg/ha		
SENCOR 75 DF (75 WG)	0.67 to 1.45 kg/ha	0.27 to 0.58 kg/ac	
LEXONE DF (75 DF)	0.67 to 1.45 kg/ha	0.27 to 0.58 kg/ac	
or plus imazethapyr	0.075 to 0.1 kg/ha		
PURSUIT (240 g/L)	0.312 to 0.420 L/ha	0.125 to 0.168 L/ac	
plus glyphosate	0.836 to 0.89 kg/ha		
ROUNDUP (360 g/L)	2.35 to 2.5 L/ha	0.94 to 1 L/ac	
GLYPHOS (360 g/L)	2.35 to 2.5 kg/ha	0.94 to 1 L/ac	
or plus glyphosateTMS	0.825 kg/ha		
TOUCHDOWN 480 (330 g/L)	2.5 L/ha	1 L/ac	
s-metolachlor	1.05 to 1.6 kg/ha		▪ Apply PP or PRE.
DUAL MAGNUM (915 g/L)	1.15 to 1.75 L/ha	0.46 to 0.7 L/ac	▪ Maximum Pursuit rate for PPI treatments is 0.312 L/ha.
plus imazethapyr	0.075 to 0.1 kg/ha		
PURSUIT (240 g/L)	0.312 to 0.42 L/ha	0.125 to 0.168 L/ac	
s-metolachlor	1.05 to 1.6 kg/ha		▪ Apply PRE.
DUAL MAGNUM (915 g/L)	1.15 to 1.75 L/ha	0.46 to 0.7 L/ac	
plus linuron	0.85 to 1.15 kg/ha		
LOROX DF (50 DF)	1.7 to 2.3 kg/ha	0.68 to 0.92 kg/ac	
AFOLAN F (480 g/L)	1.77 to 2.39 kg/ha	0.71 to 0.96 L/ac	
LINURON 480 (480 g/L)	1.77 to 2.39 L/ha	0.71 to 0.96 L/ac	
s-metolachlor	1.05 to 1.6 kg/ha		▪ Apply PRE.
DUAL MAGNUM (915 g/L)	1.15 to 1.75 L/ha	0.46 to 0.7 L/ac	
plus metobromuron	1.2 to 1.7 kg/ha		
PATORAN FL (400 g/L)	3 to 4.25 L/ha	1.2 to 1.7 L/ac	
s-metolachlor	1.05 to 1.6 kg/ha		▪ Apply PRE.
DUAL MAGNUM (915 g/L)	1.15 to 1.75 L/ha	0.46 to 0.7 L/ac	
plus metribuzin	0.421 to 0.72 kg/ha		
LEXONE DF (75 DF)	0.53 to 0.96 kg/ha	0.21 to 0.38 kg/ac	
or plus metribuzin	0.41 to 1.13 kg/ha		
SENCOR 75 DF (75 WG)	0.55 to 1.5 kg/ha	0.22 to 0.6 kg/ac	
s-metolachlor	1.05 to 1.6 kg/ha		▪ Apply PPI.
DUAL MAGNUM (915 g/L)	1.15 to 1.75 L/ha	0.46 to 0.7 L/ac	
plus metribuzin	0.42 to 0.48 kg/ha		
LEXONE DF (75 DF)	0.56 to 0.64 kg/ha	0.22 to 0.26 kg/ac	
SENCOR 75 DF (75 WG)	0.56 to 0.64 kg/ha	0.22 to 0.26 kg/ac	

Active Ingredient TRADE NAME (Formulation)	RATE (active) PRODUCT PER HA	RATE PRODUCT PER ACRE	PRECAUTIONS For more information see Chapter 4 Notes on Herbicides and Chapter 5 Notes on Adjuvants
s-metolachlor DUAL MAGNUM (915 g/L) plus metribuzin SENCOR 75 DF (75 WG) LEXONE DF (75 DF)	1.05 to 1.6 kg/ha 1.15 to 1.75 L/ha 0.5 to 1.09 kg/ha 0.67 to 1.45 kg/ha 0.67 to 1.45 kg/ha	 0.46 to 0.7 L/ac 0.27 to 0.58 kg/ac 0.27 to 0.58 kg/ac	▪ Apply PP. ▪ If emerged annual weeds are taller than 6 cm apply glyphosate prior to the tank-mix application or make an application of a 3–way tank-mix of DUAL MAGNUM plus glyphosate plus metribuzin, ▪ For improved burndown of small emerged annual weeds, the following additives may be applied: ▪ Crop oil, 28-0-0, or 10-34-0 at 50 L/1000 L; ▪ Crop oil concentrate at 10 L/1000 L; ▪ Non-ionic surfactant at 1 L/1000 L.
s-metolachlor DUAL MAGNUM (915 g/L) plus metribuzin SENCOR 75 DF (75 WG) LEXONE DF (75 DF) plus linuron LOROX DF (50 DF)	1.05 to 1.60 kg/ha 1.15 to 1.75 L/ha 0.42 to 0.55 kg/ha 0.56 to 0.73 kg/ha 0.56 to 0.73 kg/ha 0.85 to 1 kg/ha 1.7 to 2 kg/ha	 0.46 to 0.7 L/ac 0.22 to 0.29 kg/ac 0.22 to 0.29 kg/ac 0.68 to 0.8 kg/ac	▪ Apply PP. ▪ Glyphosate (1.25–2.5 L/ha (0.5–1 L/ac)) is required to control weeds that are taller than 4 cm and to control weeds that are inherently tolerant to the other herbicides used in these treatments.
s-metolachlor DUAL MAGNUM (915 g/L) plus monolinuron AFESIN (200 g/L)	1.05 to 1.6 kg/ha 1.15 to 1.75 L/ha 1.1 to 1.7 kg/ha 5.5 to 8.5 L/ha	 0.46 to 0.7 L/ac 2.2 to 3.4 L/ac	▪ Apply PRE.
Trifluralin TREFLAN (480 g/L) RIVAL (500 g/L) BONANZA 400 (400 g/L) plus imazethapyr PURSUIT (240 g/L)	0.6 to 1.155 kg/ha 1.25 to 2.4 L/ha 1.2 to 2.3 L/ha 1.5 to 2.75 L/ha 0.075 kg/ha 0.312 L/ha	 0.5 to 0.96 L/ac 0.48 to 0.92 L/ac 0.6 to 1.1 L/ac 0.125 L/ac	▪ Apply PPI.
trifluralin TREFLAN EC (480 g/L) RIVAL (500 g/L) BONANZA 400 (400 g/L) plus metribuzin LEXONE DF (75 DF) SENCOR 75 DF (75 WG) EVICT SOLUPAK (75 WG)	0.6 to 1.155 kg/ha 1.25 to 2.4 L/ha 1.2 to 2.3 L/ha 1.5 to 2.75 L/ha 0.42 to 0.55 kg/ha 0.56 to 0.73 kg/ha 0.56 to 0.73 kg/ha 0.56 to 0.73 kg/ha	 0.5 to 0.96 L/ac 0.48 to 0.92 L/ac 0.6 to 1.1 L/ac 0.22 to 0.29 kg/ac 0.22 to 0.29 kg/ac 0.22 to 0.29 kg/ac	▪ Apply PPI.
Postemergence Grass Herbicides			
clethodim SELECT (240 g/L) plus surfactant AMIGO	0.03 to 0.09 kg/ha 0.125 to 0.375 L/ha 5 to 10 L/1000 L	 0.05 to 0.15 L/ac 5 to 10 L/1000 L	▪ Soybeans are tolerant at any growth stage. ▪ Apply when annual grasses and volunteer cereals are in the 2–6 leaf stage. ▪ Use the higher rate for quackgrass control. Apply to quackgrass in the 2–5 leaf stage. ▪ Add the surfactant AMIGO at 5L/1000 L of spray solution to the low herbicide rate and 10L/1000 L of spray solution to the high herbicide rate for quackgrass control.

diclofop-methyl HOE-GRASS 284 (284 g/L)	1 kg/ha 3.5 L/ha	1.4 L/ac	• Apply when annual grasses are in the 1–4 leaf stage (2–3 leaf stage is optimum). • **Do NOT** mix with other postemergence herbicides because HOE-GRASS is inactivated. • Other postemergence herbicides must be applied at least 4 days before or after HOE-GRASS application. Crabgrass frequently escapes this treatment.
fenoxaprop-p-ethyl EXCEL SUPER (80.5 g/L)	0.054 kg/ha 0.67 L/ha	0.27 L/ac	• Apply to emerged annual grasses in the 1–6 leaf stage, which are actively growing while crop is small enough to permit thorough coverage. • A second application may be necessary to control later emerging grasses.
fluazifop-P-butyl VENTURE L (125 g/L)	0.075 kg/ha 0.6 L/ha	0.243 L/ac	• Apply at the 2 to 5 leaf stage of volunteer corn.
fluazifop-P-butyl VENTURE L (125 g/L)	0.125 to 0.25 kg/ha 1 to 2 L/ha	0.4 to 0.8 L/ac	• Apply at the 2 to 4 leaf stage of annual grasses and the 3 to 5 leaf stage of quackgrass or wirestem muhly. Use the 2L /ha rate of VENTURE for wirestem muhly.
quizalofop-p-ethyl ASSURE II (96 g/L) plus oil concentrate CANPLUS 411 or SURE-MIX	0.036 to 0.072 kg/ha 0.38 to 0.75 L/ha 5 to 10 L/1000 L 5 L/1000 L	0.15 to 0.3 L/ac 5 to 10 L/1000 L 5 L/1000 L	• Apply to emerged annual grasses and volunteer cereals in 2–leaf to tillering stage and volunteer corn and quackgrass in the 2–6 leaf stage. • Use the 0.38 L/ha (0.15 L/ac) rate of ASSURE II for control of volunteer corn, volunteer cereals and green foxtail. • The 0.5 L/ha (0.2 L/ac) rate of ASSURE II will suppress quackgrass and also control barnyard grass. • Use the 0.75 L/ha (0.3 L/ac) rate of ASSURE II for control of quackgrass. • Use the higher rate of CANPLUS 411 or SURE-MIX when wild oats and quackgrass are the target weeds or under drought conditions. • **Do NOT** apply to soybeans within 80 days of harvest.
sethoxydim POAST ULTRA (450 g/L) plus oil concentrate ASSIST or plus surfactant/solvent MERGE	0.15 to 0.2 kg/ha 0.32 to 0.47 L/ha 2 L/ha 1 L/ha	0.13 to 0.19 L/ac 0.8 L/ac 0.4 L/ac	• Apply the 0.47 L/ha (0.19 L/ac) rate for wild oats or volunteer cereal control. • Apply POAST ULTRA to emerged grasses in the 1–6 leaf stage during active growth while crop is small enough to permit thorough spray coverage. • Complete control is normally obtained 7–21 days after application. A second application may be necessary to control grasses that emerge after the first treatment. • Use MERGE for conditions or weeds requiring medium to high rates of POAST ULTRA. • Water rates of 100–200 L/ha (40–80 L/ac) provide the best results.
sethoxydim POAST ULTRA (450 g/L) plus surfactant/solvent MERGE	0.5 kg/ha 1.1 L/ha 1 to 2 L/ha	0.45 L/ac 0.4 to 0.8 L/ac	• Apply at 1–3 leaf stage of actively growing quackgrass in 110–200 L/ha (44–80 L/ac) water. • Thorough preplant tillage will result in more uniform quackgrass emergence. • Crop competition and inter-row cultivation 7–14 days after application will assist in quackgrass control for 6–8 weeks.

Active Ingredient TRADE NAME (Formulation)	RATE (active) PRODUCT PER HA	RATE PRODUCT PER ACRE	PRECAUTIONS (For more information, see Chapter 4, Notes on Herbicides and Chapter 5, Notes on Adjuvants)
Postemergence Broadleaf Herbicides			
acifluorfen BLAZER (240 g/L)	0.6 kg/ha 2.5 L/ha	1 L/ac	▪ Apply to emerged weeds up to 10 cm in height (refer to labels for weed heights) when soybeans are in the 1–3 trifoliate leaf stage. ▪ **Do NOT** apply before the first trifoliate leaf stage of the soybeans. ▪ Good spray coverage on the weeds is important for good weed control. ▪ Soybeans may exhibit speckling, bronzing and/or leaf burn. The trifoliate leaf emerging at the time of application may be distorted. Soybeans usually outgrow these conditions and continue to grow at a normal rate with no adverse effect on vigour, maturity, or crop yield. ▪ **Do NOT** apply BLAZER to soybeans that have been subjected to stress (see product label). ▪ **Do NOT** add oils or surfactants to applications of BLAZER at 2.5 L/ha alone.
acifluorfen BLAZER (240 g/L) plus oil concentrate ASSIST	0.3 kg/ha 1.25 L/ha 5 L/1000 L	0.5 L/ac 5 L/1000 L	▪ Apply to emerged redroot pigweed up to and including the 4–leaf stage and to common ragweed up to and including the 8–leaf stage when soybeans are in the 1–3 trifoliate leaf stage. ▪ **Do NOT** apply before the first trifoliate leaf stage of the soybeans. ▪ Good spray coverage on the weeds is important for good weed control. ▪ Soybeans may exhibit speckling, bronzing and/or leaf burn. The trifoliate leaf emerging at the time of application may be distorted. Soybeans usually outgrow these conditions and continue to grow at a normal rate with no adverse affects on vigour, maturity or crop yield.
bentazon BASAGRAN FORTÉ (480 g/L)	0.84 to 1.08 kg/ha 1.75 to 2.25 L/ha	0.7 to 0.9 L/ac	▪ Apply when soybeans are in unifoliate to 4th trifoliate leaf stage and when weeds are small and actively growing. ▪ Temporary crop injury may occur under abnormally hot, humid conditions. ▪ Cool weather or drought may delay control. ▪ For improved and more consistent control of velvetleaf and lamb's-quarters, 10 L/ha of 28% urea ammonium nitrate (UAN) or 6 L/ha of liquid ammonium sulphate may be added. The addition of either nitrogen source may cause slight leaf burn, but new growth is normal and crop vigour is not reduced. ▪ Use the higher rate of BASAGRAN FORTÉ when weed pressure is high, weeds are large or conditions for activity are unfavourable.
chlorimuron-ethyl CLASSIC (25 DF) plus non-ionic surfactant	9 g/ha 36 g/ha 2 L/1000 L	14 g/ac 2 L/1000 L	▪ **Do NOT** use on soils with pH ≥ 7.5. ▪ Optimal timing for broadleaf control is when the soybeans are in the 1–3 trifoliate stage of growth. ▪ **Do NOT** apply before the first trifoliate is fully expanded or after the initiation of flowering. ▪ Addition of 28% UAN is recommended for improved control of velvetleaf.
cloransulam-methyl FIRSTRATE plus non-ionic surfactant plus liquid fertilizer (28-0-0 or 32-0-0)	17.5 g/ha 20.8 g/ha 2.5 L/1000 L 25 L/1000 L	8.5 g/ac 2.5 L/1000 L 25 L/1000 L	▪ Apply up to the 8–leaf stage for common ragweed and cocklebur, 6–leaf stage for giant ragweed, and 4–leaf stage for velvetleaf. ▪ Apply any time prior to flowering stage of soybeans. ▪ Application prior to full emergence of first trifoliate may cause temporary yellowing of soybeans.

fomesafen REFLEX (240 g/L) plus non-ionic surfactant AGRAL 90 or plus mineral oil/surfactant TURBOCHARGE	0.24 kg/ha 1 L/ha 2.5 L/1000 L 5 L/1000 L	 0.4 L/ac 2.5 L/1000 L 5 L/1000 L	▪ Apply early postemergence at 1–2 trifoliate to crop when weeds are small and actively growing (2–4 leaf stage). ▪ Use 200–350 L/ha (80–140 L/ac) water. Use higher rates of water and pressure for a heavy weed or crop canopy. ▪ Some bronzing may occur to soybean leaves at the time of application, but plants outgrow these effects without harming maturity or yield. ▪ **Do NOT** apply Reflex to any field more often than once every 2 years. ▪ **Do NOT** apply to soybeans under stress. ▪ Some rotational cropping restrictions apply (see Table 2).
thifensulfuron- methyl PINNACLE (75 DF) plus surfactant AGRAL 90, CITOWETT, AGSURF, or SUPER SPREADER STICKER	4.1 to 6 g/ha 5.5 to 8 g/ha 1 L/1000 L	 2.2 to 3.2 g/ac 1 L/1000 L	▪ Apply to emerged weeds up to 10 cm in height when soybeans have the first trifoliate leaf fully expanded. ▪ **Do NOT** apply to soybeans, which have initiated flowering. ▪ The higher rate should be used for lamb's-quarters and velvetleaf. ▪ The addition of UAN (28-0-0) at 4% v/v will enhance the control of velvetleaf.
Postemergence Broadleaf Herbicides — STS tolerant varieties only			
chlorimuron-ethyl/ thifensulfuron-methyl RELIANCE STS [1] ((1.75:1) 33DF) plus non-ionic surfactant	9.2 to 14.1 g/ha 27.6 to 42.8 g/ha 2 L/1000 L	 11.2 to 17.3 g/ac 2 L/1000 L	▪ Optimal timing for weed control usually coincides with the 1–3 trifoliate stage of the soybeans. ▪ Use only on STS varieties of soybean. ▪ At the 17.3 g/ac rate each water-soluble pack treats 1 ac. ▪ **Do NOT** break open individual packages. ▪ **Do NOT** use on soils with pH ≥7.5. ▪ Some rotational cropping restrictions apply (see Table 2). ▪ Use the high rate for control of ragweed, lamb's-quarters, and/or velvetleaf. ▪ Addition of 28% UAN is recommended for improved velvetleaf control.
Postemergence Grass and Broadleaf Herbicides			
imazamox + fomesafen VIPER [1] (VIPER (70WG) + REFLEX (240 g/L)) plus non-ionic surfactant AGRAL 90 plus liquid fertilizer 28-0-0, 32-0-0	25 g/ha + 0.2 kg/ha 36 g/ha + 0.83 L/ha 2.5 L/1000 L 2 L/ha	 14.5 g/ac + 0.336 L/ac 2.5 L/1000 L 0.8 L/ac	▪ VIPER is only available in a package containing both imazamox and REFLEX. ▪ Apply postemergence to the crop after the unifoliate stage. ▪ Weeds should be in the 1–6 leaf stage and actively growing. ▪ Some rotational cropping restrictions apply (see label and Table 2).
imazamox + bentazon MERIDIAN PLUS [1] (MERIDIAN (70 WG) + BASAGRAN FORTÉ (480 g/L)) plus liquid fertilizer 28-0-0 or 32-0-0	0.025 + 0.6 kg/ha 36 g/ha + 1.25 L/ha 2 L/ha	 14.5 g/ac + 0.5 L/ac 0.8 L/ac	▪ Available as a co-pack containing imazamox and BASAGRAN FORTÉ. ▪ Apply postemergence to actively growing weeds in the 2–6 leaf stage. ▪ Apply from cotyledon to the fourth trifoliate stage of soybeans.

Active Ingredient TRADE NAME (Formulation)	RATE (active) PRODUCT PER HA	RATE PRODUCT PER ACRE	PRECAUTIONS (For more information see Chapter 4 Notes on Herbicides and Chapter 5 Notes on Adjuvants)
imazethapyr PURSUIT (240 g/L) plus non-ionic surfactant plus liquid fertilizer 28-0-0, 10-34-0, or 32-0-0	0.075 to 0.1 kg/ha 0.312 to 0.42 L/ha 2.5 L/1000 L 2 L/ha	 0.125 to 0.168 L/ac 2.5 L/1000 L 0.8 L/ac	▪ Apply when the weeds are up to the 2 true leaf stage. ▪ Some rotational cropping restrictions apply (see label and Table 2). ▪ Use only once per season.
imazethapyr PURSUIT plus cloransulan-methyl FIRSTRATE plus non-ionic surfactant plus liquid fertilizer (28-0-0 or 32-0-0)	75 g/ha 0.312 L/ha 17.5 g/ha 20.8 g/ha 2.5 L/1000 L 2L/ha	 0.125 L/ac 8.5 g/ac 2.5 L/1000 L 0.8 L/ac	▪ Apply when weeds are up to the 2-true leaf stage. ▪ Use for control of annual grasses, lamb's quarters and redroot pigweed.
imazethapyr/ bentazon CLEAN SWEEP (PURSUIT (240 g/L) + BASAGRAN FORTÉ (480 g/L) plus liquid fertilizer 28-0-0, 10-34-0 or 32-0-0	0.075 + 0.84 kg/ha 0.312 + 1.75 L/ha 2 L/ha	 0.125 + 0.7 L/ac 0.8 L/ac	▪ Available as a co-pack containing PURSUIT and BASAGRAN FORTÉ. ▪ Apply postemergence to actively growing weeds in the 2–6 leaf stage. ▪ Some rotational cropping restrictions apply (see label and Table 2).
Postemergence Grass and Broadleaf Herbicides — Roundup Ready (Glyphosate Tolerant) Varieties Only			
glyphosate ROUNDUP TRANSORB VANTAGE PLUS (360 g/L)	0.9 kg/ha 2.5 L/ha	 1 L/ac	▪ For use only with pedigreed (certified) soybean seed designated as "ROUNDUP READY SOYBEANS". ▪ Apply between the first trifoliate leaf stage and the full flower stage of the soybeans. ▪ Weeds are more easily controlled and weed competition avoided when applications are made when weeds are small, although weeds up to 25 cm tall will be controlled. ▪ A second application may be made for later flushes emerging after the initial application. ▪ Use 100–200 L/ha (40–80 L/ac) water.
glyphosate ROUNDUP TRANSORB VANTAGE PLUS (360 g/L)	1.8 kg/ha or 0.9 + 0.9 kg/ha 5 L/ha or 2.5 + 2.5 L/ha	 2 L/ac or 1 + 1 L/ac	▪ For use only with pedigreed (certified) soybean seed designated as "ROUNDUP READY SOYBEANS". ▪ Apply when milkweed, perennial sow-thistle and Canada thistle are 15–60 cm and nutsedge is 5–15 cm in height and actively growing for best results. ▪ If the sequential applications are used they should be at least 2 weeks apart for best results.
Postemergence Tank-mix Options			
acifluorfen BLAZER (240 g/L) plus bentazon BASAGRAN FORTÉ (480 g/L)	0.3 kg/ha 1.25 L/ha 0.6 kg/ha 1.25 L/ha	 0.5 L/ac 0.5 L/ac	▪ Use when common ragweed and/or redroot pigweed is the dominant weed(s).

acifluorfen	0.15 kg/ha		▪ Use when lamb's-quarter is the dominant weed.
BLAZER (240 g/L)	0.63 L/ha	0.25 L/ac	
plus bentazon	0.84 kg/ha		
BASAGRAN FORTÉ (480 g/L)	1.75 L/ha	0.7 L/ac	
fenoxaprop-p-ethyl	0.054 kg/ha		▪ If annual broadleaf and grassy weeds are not in the correct stage for a tank-mix application, use a split application at the correct stage for each product.
EXCEL SUPER (80.5 g/L)	0.67 L/ha	0.27 L/ac	
plus bentazon	0.84 to 1.08 kg/ha		
BASAGRAN FORTÉ (480 g/L)	1.75 to 2.25 L/ha	0.7 to 0.9 L/ac	
fenoxaprop-p-ethyl	0.054 kg/ha		▪ If broadleaf and grassy weeds are not in the correct stage for a tank-mix application, use a split application at the correct stage for each product.
EXCEL SUPER (80.5 g/L)	0.67 L/ha	0.27 L/ac	
plus bentazon	0.84 to 1.08 kg/ha		
BASAGRAN FORTÉ (480 g/L)	1.75 to 2.25 L/ha	0.7 to 0.9 L/ac	
plus thifensulfuron-methyl	4.1 to 6 g/ha		
PINNACLE (75 DF)	5.5 to 8 g/ha	2.2 to 3.2 g/ac	
fenoxaprop-p-ethyl	0.054 kg/ha		▪ If broadleaf and grassy weeds are not in the correct stage for a tank-mix application, use a split application at the correct stage for each product.
EXCEL SUPER (80.5 g/L)	0.67 L/ha	0.27 L/ac	
plus thifensulfuron-methyl	4.1 to 6 g/ha		
PINNACLE (75 DF)	5.5 to 8 g/ha	2.2 to 3.2 g/ac	
fluazifop-p-butyl	0.125 to 0.25 kg/ha		▪ Apply at the 2–4 leaf stage of annual grasses and broadleaf weeds. ▪ **Do NOT** tank-mix if weed leaf stages are not at the correct timing.
VENTURE 25G (25 DG)	0.5 to 1 kg/ha	0.2 to 0.4 kg/ac	
plus bentazon	0.84 to 1.08 kg/ha		
BASAGRAN FORTÉ (480 g/L)	1.75 to 2.25 L/ha	0.7 to 0.9 L/ac	
plus mineral oil/surfactant			
TURBOCHARGE	5 L/1000 L	5 L/1000 L	
fluazifop-p-butyl	0.125 to 0.25 kg/ha		▪ Apply at the 2–4 leaf stage of annual grasses and broadleaf weeds. ▪ **Do NOT** tank-mix if weed leaf stages are not at the correct timing.
VENTURE 25G (25 DG)	0.5 to 1 kg/ha	0.2 to 0.4 kg/ac	
plus bentazon	0.84 to 1.08 kg/ha		
BASAGRAN FORTÉ (480 g/L)	1.75 to 2.25 L/ha	0.7 to 0.9 L/ac	
plus thifensulfuron-methyl	4.1 to 6 g/ha		
PINNACLE (75 DF)	5.5 to 8 g/ha	2.2 to 3.2 g/ac	
plus mineral oil/surfactant			
TURBOCHARGE	5 L/1000 L	5 L/1000 L	
fluazifop-p-butyl	0.125 to 0.25 kg/ha		▪ Apply at 2–4 leaf stage of annual grasses and 2–leaf stage of broadleaf weeds.
VENTURE 25G (25 DG)	0.5 to 1 kg/ha	0.2 to 0.4 kg/ac	
plus imazethapyr	0.075 to 0.1 kg/ha		
PURSUIT (240 g/L)	0.312 to 0.42 L/ha	0.125 to 0.168 L/ac	
plus mineral oil/surfactant			
TURBOCHARGE	5 L/1000 L	5 L/1000 L	

Active Ingredient TRADE NAME (Formulation)	RATE (active) PRODUCT PER HA	RATE PRODUCT PER ACRE	PRECAUTIONS (For more information, see Chapter 4, Notes on Herbicides and Chapter 5, Notes on Adjuvants)
fluazifop-p-butyl	0.125 to 0.25 kg/ha		• Apply early postemergence at 2–4 leaf stage of annual weeds and 1–2 trifoliate to the crop. • Add VENTURE to the tank first and agitate, followed by REFLEX and TURBOCHARGE last. • **Do NOT** tank-mix if weed leaf stages are not at the correct timing.
VENTURE 25G (25 DG)	0.5 to 1 kg/ha	0.2 to 0.4 kg/ac	
plus fomesafen	0.24 kg/ha		
REFLEX (240 g/L)	1 L/ha	0.4 L/ac	
plus mineral oil/surfactant			
TURBOCHARGE	5 L/1000 L	5 L/1000 L	
imazethapyr	0.075 kg/ha		• Use the lower rate of REFLEX for ragweed only. • Use the higher rate of REFLEX for lamb's-quarters.
PURSUIT (240 g/L)	0.312 L/ha	0.125 L/ac	
plus fomesafen	0.19 to 0.24 kg/ha		
REFLEX (240 g/L)	0.8 to 1 L/ha	0.32 to 0.4 L/ac	
plus non-ionic surfactant			
AGRAL 90	2.5 L/1000 L	2.5 L/1000 L	
plus liquid fertilizer	2 L/ha	0.8 L/ac	
imazethapyr	0.075 kg/ha		• Apply postemergence to actively growing weeds in the 2–6 leaf stage. • Some rotational cropping restrictions apply (see label and Table 2).
PURSUIT (240 g/L)	0.312 L/ha	0.125 L/ac	
plus bentazon	0.6 to 0.84 kg/ha		
BASAGRAN FORTÉ (480 g/L)	1.25 to 1.75 L/ha	0.5 to 0.7 L/ac	
plus liquid fertilizer			
28-0-0, 10-34-0, or 32-0-0	2 L/ha	0.8 L/ac	
fomesafen	0.24 kg/ha		• Apply early postemergence at the 2–4 leaf stage of weeds and 1 to 2–trifoliate stage of the crop.
REFLEX (240 g/L)	1 L/ha	0.4 L/ac	
plus thifensulfuron-methyl	6 g/ha		
PINNACLE (75DF)	8 g/ha	3.2 g/ac	
plus non-ionic surfactant			
AGRAL 90	2.5 L/1000 L	2.5 L/1000 L	
quizalofop-p-ethyl	0.06 kg/ha		• Apply to soybeans within the 1–4 leaf trifoliate stage, ensuring the 1st trifoliate is fully expanded before application. • **Do NOT** apply to soybeans, which have initiated flowering. • If leaf stages of the grass and broadleaf weeds do not coincide, a sequential application of the grass and broadleaf herbicides is required to ensure satisfactory control. • Use the higher rate of CANPLUS 411 or SURE-MIX under conditions not conducive to good growth.
ASSURE II (96 g/L)	0.63 L/ha	0.25 L/ac	
plus thifensulfuron-methyl	4.1 to 6 g/ha		
PINNACLE (75 DF)	5.5 to 8 g/ha	2.2 to 3.2 g/ac	
plus bentazon	0.84 to 1.08 kg/ha		
BASAGRAN FORTÉ (480 g/L)	1.75 to 2.25 L/ha	0.7 to 0.9 L/ac	
plus oil concentrate			
CANPLUS 411	5 to 10 L/1000 L	5 to 10 L/1000 L	
or SURE-MIX	5 L/1000 L	5 L/1000 L	

quizalofop-p-ethyl ASSURE II (96 g/L) plus thifensulfuron-methyl PINNACLE (75 DF) plus oil concentrate CANPLUS or SURE-MIX	0.048 kg/ha 0.5 L/ha 4.1 to 6 g/ha 5.5 to 8 g/ha 5 to 10 L/1000 L 5 L/1000 L	 0.2 L/ac 2.2 to 3.2 g/ac 5 to 10 L/1000 L 5 L/1000 L	• Delay application until soybeans have 1–2 fully expanded trifoliate leaves. • **Do NOT** apply to soybeans, which have initiated flowering. • If leaf stages of the grass and broadleaf weeds do not coincide, a sequential application of the grass and broadleaf herbicides is required to ensure satisfactory control. • Use the higher rate of CANPLUS 411 or SURE-MIX under conditions not conducive to good growth. • Velvetleaf control may be reduced with a tank-mix application. • For optimum control, make separate applications of PINNACLE and ASSURE.
quizalofop-p-ethyl ASSURE II (96 g/L) plus chlorimuron-ethyl CLASSIC plus oil concentrate CANPLUS or SURE-MIX	0.036 to 0.060 kg/ha 0.38 to 0.63 L/ha 9.0 g/ha 36 g/ha 0.5 to 1.0% 1 L/100 L 0.5 L/100 L	 0.15 to 0.255 L/ac 14 g/ac 1 L/ 100 L 0.5 L/100 L	• Delay application until soybeans have 1–2 fully expanded trifoliate leaves. • **Do NOT** apply to soybeans, which have initiated flowering. • If leaf stages of the grass and broadleaf weeds do not coincide, a sequential application of the grass and broadleaf herbicides is required to ensure satisfactory control. • If target weeds are yellow foxtail or quackgrass use a minimum of 0.5 L/ha ASSUREII and for best control of these species use ASSURE II at a rate of 0.63 L/ha.
thifensulfuron- methyl PINNACLE (75 DF) plus bentazon BASAGRAN FORTÉ (480 g/L)	4.1 to 6 g/ha 5.5 to 8 g/ha 0.84 to 1.08 kg/ha 1.75 to 2.25 L/ha	 2.2 to 3.2 g/ac 0.7 to 0.9 L/ac	• Apply to emerged weeds when soybeans have the first trifoliate leaf fully expanded. • **Do NOT** apply to soybeans that have initiated flowering. • If Canada thistle, yellow nutsedge and field bindweed are target species a second application may be required. • UAN (28-0-0) should not be added to this tank-mix.
Postemergence Tank-mix Options — STS tolerant varieties only			
quizalofop-p-ethyl ASSURE II (96 g/L) plus chlorimuron-ethyl/ thifensulfuron-methyl RELIANCE STS plus oil concentrate CANPLUS or SURE-MIX	0.036 to 0.060 kg/ha 0.38 to 0.63 L/ha 14.1 g/ha 42.8 g/ha 0.5 to 1.0% 1 L/100 L 0.5 L/100 L	 0.15 to 0.255 L/ac 17.3 g/ac 1 L/ 100 L 0.5 L/100 L	• Delay application until soybeans have 1–2 fully expanded trifoliate leaves. • **Do NOT** apply to soybeans that have initiated flowering. • If leaf stages of the grass and broadleaf weeds do not coincide, a sequential application of the grass and broadleaf herbicides is required to ensure satisfactory control. • If target weeds are yellow foxtail or quackgrass use a minimum of 0.5 L/ha ASSUREII and for best control of these species use ASSURE II at a rate of 0.63 L/ha.
Spot Treatment			
glyphosate* glyphosate (360 g/L)	1.71 to 2.52 kg/ha 4.75 to 7 L/ha	 1.9 to 2.8 L/ac	• Apply as a spot treatment when quackgrass has more than 3–4 leaves per stem, thistles are at bud to flower stage. • The crop will be killed in the sprayed area. • Applications may be made up to pod set but not after seed set.
glyphosate* glyphosate (360 g/L)	2.52 to 4.32 kg/ha 7 to 12 L/ha	 2.8 to 4.8 L/ac	• Apply as a spot treatment when milkweed, dogbane and bindweed are at bud to flower stage. • The crop will be killed in the sprayed area.

Active Ingredient TRADE NAME (Formulation)	RATE (active) PRODUCT PER HA	RATE PRODUCT PER ACRE	PRECAUTIONS (For more information, see Chapter 4 Notes on Herbicides and Chapter 5 Notes on Adjuvants.)
Wick Wiper and Roller Application			
glyphosate* glyphosate (360 g/L)	0.36 kg/2L water 1 L/2L water		▪ Apply to weeds that extend above the crop sufficiently to allow good contact with the application equipment. ▪ Be careful not to contact the crop with the equipment or allow the chemical solution to drip from the applicator on to the crop. ▪ A 33% solution of the herbicide mixture provides good control of most weeds.
Preharvest			
diquat REGLONE DESICCANT (240 g/L) plus surfactant AGRAL 90	0.30 to 0.55 kg/ha 1.25 to 2.3 L/ha 1 L/1000 L	 0.5 to 0.92 L/ac 1 L/1000 L	▪ Apply in 225 L/ha water to burn off weeds when 80% natural crop leaf defoliation has occurred and 80% of the pods have turned yellow. ▪ Avoid regrowth by targeting spray within 7 days of variety maturity date and harvest 5–7 days after application. ▪ For ground application use 1.25–1.7 L/ha (0.5–0.68 L/ac). ▪ For aerial application use 1.7–2.3 L/ha (0.68–0.92 L/ac). ▪ Beware of drift to adjacent crops or plants.
glyphosate* glyphosate (360 g/L)	0.9 kg/ha 2.5 L/ha	 1 L/ac	▪ Apply in 50–100 L/ha (20–40 L/ac) water when the crop is 30% grain moisture or less. ▪ **Do NOT** apply to crops grown for seed. ▪ Apply at least 7 days prior to harvest when pod tissue is dry and brown and 80–90% of original leaves have dropped.

* Various formulations available, see Table 1. See label for specific uses and rates.

Stages Of Soybean Leaf Development

Cotyledon **Unifoliate** **First Trifoliate** **Second Trifoliate** **Third Trifoliate**

TABLE 16 Soybean Postemergence Herbicides Leaf Stages [1]

Trade Name	Stage of Soybeans (leaf stage)	Annual Grasses									Annual Broadleaf											Perennials		
		barnyard grass	crabgrass	fall panicum	green foxtail	yellow foxtail	old witchgrass	proso millet	volunteer corn	volunteer wheat	buckwheat, wild	cocklebur	jimsonweed	lady's-thumb	lamb's-quarters	wild mustard	nightshade	pigweed	common ragweed	giant ragweed	velvetleaf	quackgrass control	quackgrass suppression*	wirestem muhly
ASSURE II		2–ET			2–ET				2–6	2–ET														
rate ml/ac		200			150				150	150												300	200	
EXCEL SUPER		1–6	1–6	1–6	1–6	1–6	1–6	1–6	1–6															
rate ml/ac		268	268	268	268	268	268	268	268															
POAST ULTRA		1–6	1–6	1–6	1–6	1–6	1–6	1–6	1–6														1–3	
rate ml/ac		130–190	130–190	130–190	130–190	130–190	130–190	130–190	130–190														450	
SELECT		2–6	2–6	2–6	2–6	2–6	2–6	2–6	2–6	2–4														
rate ml/ac		75	75	75	75	75	75	75	75	50												150	75	
VENTURE L		2–5			2–4	2–4		2–4	2–4													3–5	3–5	3–5
rate ml/ac		320			400	400		400	240													800	400	800
BASAGRAN [2]	uni to 2-tri											10	10	10	8	10		4	6	4	6			
rate L/ac												0.9**	0.9	0.9**	0.9	0.9**		0.9	0.9	0.9	0.9**			
BLAZER [2]	1 to 3-tri											4	10	8	2	10	6	4–6	8					
rate L/ac												1	1	1	1	1	1	0.5-1	0.5-1					
CLASSIC [2]	1 to 3-tri																	2–8	2–6		2–4			
CLEANSWEEP [2,3]	uni to 2-tri	6			4	4						6		6	6	6	4	12	6		4			
FIRSTRATE												4–8	2–4						4–8	4–6	2–4			
rate g/ac												8.5	8.5						8.5	8.5	8.5			
MERIDIAN PLUS [3]		3–6		3–6	1–4	1–4						c–4 *		c–4	c–4	c–4	c–4	c–4	c–4		c–4			
PINNACLE [2]														2–8	2–6	2–8		2–8			2–4			
rate g/ac	1-tri to flowering													2.2	3.2	2.2		2.2			3.2			
PURSUIT [2]		6			4	4	2				2	2				2	2	12	2		8			
REFLEX [2]	1 to 2-tri											4		4	3*	4	4	4	4		3*			
RELIANCE STS [2,4]	1 to 3-tri													2–8	2–6	2–8		2–8	2–6		2–6			
rate g/ac														11	17	11		11	17		17			
ROUNDUP, VANTAGE [4]	1-tri to bud	25 cm	25 cm	25 cm	25 cm	25 cm	25 cm	25 cm	25 cm	25 cm	25 cm	25 cm	25 cm	15 cm	25 cm	25 cm	25 cm	25 cm	25 cm	25 cm	25 cm			
VIPER [3]		3–6		3–6	1–4	1–4						c–4		c–4	c–4	c–4	c–4	c–4	c–4		c–4			

leaf stage abbrev.: ET - early tillering of grasses; c - cotyledon stage, uni - unifoliate, tri - trifoliate

* suppression only

** lower rates have lower leaf stage

[1] Expressed as leaf stages except as indicated

[2] maximum leaf stage for control

[3] Indicates herbicides sold as a co-pack under this name.

[4] Use only on appropriate herbicide tolerant varieties

Notes:

Weed control ratings are given as 0-9 where 0 indicates no control and 9 indicates 90%-100% control under ideal conditions.
Ratings are subjective values based on best available information and give general comparisons based on use as descibed in this guide.
Crop tolerance ratings are E - Excellent, G - Good, F - Fair, P - Poor.
Under unfavorable conditions (eg., too dry, too wet, too cold, or poor application) the herbicides may not be as effective as indicated.
Ratings may vary with weed and crop stage and with the timing and rates of the product(s) being used.
Ratings in **BOLD** indicate the weed is listed on the product label for control or suppression.
Please see product label for more information on registered weed species, product uses and precautions.

TABLE 17. Soybean Herbicide Weed Control Ratings

Trade Name	Grasses								Annual Broadleaves										Perennials							Crop Tolerance
	barnyard grass(a)	crabgrass	fall panicum	foxtail, giant	foxtail, green	foxtail, yellow	old witch grass(a)	proso millet	buckwheat, wild	cocklebur	fleabane, Canada	lady's thumb	lamb's-quarters(a)	mustards(a)	nightshades, annual (b)	pigweeds(a,b)	ragweed, common(a,b)	ragweed, giant	velvetleaf	bindweed, field	horsetail	milkweed	nutsedge	quackgrass	sow-thistle	thistle, Canada	
Soil applied grass herbicides																										
AXIOM	**9**	9	8	**8**	**9**	**9**	9	4	?	?	0	8	**8**	9	8	**9**	7	7	6	?	0	0	7	0	0	0	G
DUAL MAGNUM	**9**	**9**	**8**	**8**	**9**	**9**	**9**	4	2	2	0	2	7	2	**8**	**8**	4	3	2	0	0	0	**8**	0	0	0	G
FRONTIER	**9**	**9**	**8**	**8**	**9**	**9**	**9**	4	2	2	0	2	7	2	**8**	**8**	4	3	2	0	0	0	**8**	0	0	0	G
TREFLAN, BONANZA, RIVAL	**9**	**9**	**8**	9	**9**	**9**	9	6	5	2	0	2	**8**	2	2	**8**	2	1	2	2	2	2	2	2	2	2	G
Soil applied broadleaf herbicides																										
AFESIN	**5**	**5**	5	**5**	**5**	**5**	5	5	**8**	5	5	**9**	**9**	9	7	**9**	**8**	6	6	2	2	2	2	2	2	2	G
AFOLAN, LOROX	**5**	**5**	5	**5**	**5**	**5**	5	5	**8**	5	5	**9**	**9**	9	7	**9**	**8**	6	**6**	2	2	2	2	2	2	2	G
EVICT, LEXONE, SENCOR	**7**	6	**7**	**5**	**5**	**5**	**8**	3	7	7	5	**9**	**9**	**9**	3	**9**	**8**	7	**8**	2	2	2	2	2	2	2	G
PATORAN	**5**	**5**	5	5	**5**	5	**5**	5	8	5	5	**9**	**9**	**9**	7	**9**	**8**	6	6	2	2	2	2	2	2	2	G
Soil applied grass and broadleaf herbicides																										
BOUNDARY	**9**	**9**	**8**	**8**	**9**	**9**	**9**	5	7	7	5	**9**	**9**	**9**	**8**	**9**	**8**	7	**8**	2	2	2	**8**	2	2	2	G
BROADSTRIKE DUAL MAGNUM	**9**	**9**	**8**	**8**	**9**	**9**	**9**	6	7	7	**9**	**9**	**9**	**9**	**9**	**9**	**8**	7	**9**	2	8	?	**8**	0	3	4	E
BROADSTRIKE TREFLAN	**9**	**9**	**8**	9	**9**	**9**	9	6	7	7	9	9	**9**	9	**9**	**9**	**8**	7	**9**	2	2	?	5	2	3	4	E
CONQUEST [1]	**8**	7	7	**9**	**9**	**9**	8	7	8	**8**	2	**9**	**9**	**9**	**9**	**9**	6	**9**	2	2	2	7	6	2	2	G
FIRSTRATE	0	0	0	0	0	0	0	0	?	**9**	**9**	?	**9**	?	**2**	**9**	**9**	**9**	**9**	?	2	?	?	2	6	?	E
PURSUIT	**8**	7	7	**9**	**9**	**9**	**8**	7	8	7	2	**9**	**9**	**9**	**9**	**9**	**8**	6	**9**	2	2	2	7	6	2	2	E
VALOR	**9**	9	9	**9**	**9**	**9**	9	8	8	7	2	9	**9**	9	**9**	**9**	**8**	6	**9**	2	2	2	7	6	2	2	E

TABLE 17. Soybean Herbicide Weed Control Ratings

Trade Name	Grasses								Annual Broadleaves										Perennials							Crop Tolerance
	barnyard grass(a)	crabgrass	fall panicum	foxtail, giant	foxtail, green	foxtail, yellow	old witch grass(a)	proso millet	buckwheat, wild	cocklebur	fleabane, Canada	lady's thumb	lamb's-quarters(a)	mustards(a)	nightshades, annual (b)	pigweeds(a,b)	ragweed, common(a,b)	ragweed, giant	velvetleaf	bindweed, field	horsetail	milkweed	nutsedge	quackgrass	sow-thistle	thistle, Canada	
soil applied herbicides																											
AXIOM + LOROX	9	9	8	8	9	9	9	5	8	5	5	9	9	9	8	9	8	7	6	2	2	2	7	2	2	2	G
AXIOM + SENCOR	9	9	8	8	9	9	9	5	7	7	5	9	9	9	8	9	8	7	8	2	2	2	7	2	2	2	G
AXIOM + SENCOR + LOROX	9	9	8	8	9	9	9	5	8	7	5	9	9	9	8	9	8	7	8	2	2	2	7	2	2	2	G
AXIOM + PURSUIT	9	9	8	8	9	9	9	7	8	7	?	9	9	9	8	9	8	7	8	2	2	2	7	2	2	2	G
BROADSTRIKE DUAL + FIRSTRATE	9	9	8	8	9	9	9	6	7	9	9	9	9	9	9	9	9	9	9	2	2	2	7	6	2	2	G
DUAL + AFOLAN, LOROX + EVICT, LEXONE, SENCOR	9	9	8	8	9	9	9	5	8	7	5	9	9	9	8	9	8	7	8	2	2	2	8	2	2	2	G
DUAL MAGNUM + AFESIN	9	9	8	8	9	9	9	5	8	5	5	9	9	9	8	9	8	6	6	2	2	2	8	2	2	2	G
DUAL MAGNUM + AFOLAN, LINURON 480, LOROX	9	9	8	8	9	9	9	5	8	5	5	9	9	9	8	9	8	6	6	2	2	2	8	2	2	2	G
DUAL MAGNUM + LEXONE, SENCOR	9	9	8	8	9	9	9	5	7	7	5	9	9	9	8	9	8	7	8	2	2	2	8	2	2	2	G
DUAL MAGNUM + PATORAN	9	9	8	8	9	9	9	5	8	5	5	9	9	9	8	9	8	7	6	2	2	2	8	2	2	2	G
DUAL MAGNUM+ PURSUIT	9	9	8	8	9	9	9	7	8	7	?	9	9	9	8	9	8	7	6	2	2	2	8	2	2	2	G
FRONTIER + AFOLAN, LOROX	9	9	8	8	9	9	9	5	8	5	5	9	9	9	8	9	8	6	9	2	2	2	8	6	2	2	G
FRONTIER + EVICT, LEXONE, SENCOR	9	9	8	8	9	9	9	5	7	7	5	9	9	9	8	9	8	6	6	2	2	2	8	2	2	2	G
FRONTIER + AFOLAN, LOROX + EVICT, LEXONE, SENCOR	9	9	8	8	9	9	9	5	8	7	5	9	9	9	8	9	8	7	8	2	2	2	8	2	2	2	G
FRONTIER + PURSUIT	9	9	8	9	9	9	9	7	8	7	?	9	9	9	9	9	8	6	9	2	2	2	8	6	2	2	G
PURSUIT + EVICT, LEXONE, SENCOR	8	7	7	9	9	9	8	5	8	7	5	9	9	9	9	9	8	7	9	2	2	2	7	6	2	2	G
PURSUIT + AFOLAN, LINURON 480, LOROX	8	7	7	9	9	9	8	7	8	7	5	9	9	9	9	9	8	6	9	2	2	2	7	6	2	2	G
PURSUIT + FIRSTRATE	8	7	7	9	9	9	8	7	8	9	9	9	9	9	9	9	9	9	9	2	2	2	7	6	2	2	E
PURSUIT + TREFLAN, BONANZA, RIVAL	9	9	8	9	9	9	9	7	8	7	?	9	9	9	9	9	8	6	9	2	2	2	7	6	2	2	G

TABLE 17. Soybean Herbicide Weed Control Ratings

Trade Name	Grasses								Annual Broadleaves												Perennials							Crop Tolerance
	barnyard grass(a)	crabgrass	fall panicum	foxtail, giant	foxtail, green	foxtail, yellow	old witch grass(a)	proso millet	buckwheat, wild	cocklebur	fleabane, Canada	lady's thumb	lamb's-quarters(a)	mustards(a)	nightshades, annual (b)	pigweeds(a,b)	ragweed, common(a,b)	ragweed, giant	velvetleaf	bindweed, field	horsetail	milkweed	nutsedge	quackgrass	sow-thistle	thistle, Canada	
TREFLAN, BONANZA, RIVAL + EVICT, LEXONE, SENCOR	9	9	8	9	9	9	9	6	7	7	5	9	9	9	3	9	8	7	8	2	2	2	2	2	2	2	G
[redacted]																											
ASSURE II	9	8	9	9	9	8	9	9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9	0	0	E
EXCEL SUPER	9	8	9	9	9	9	9	9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	E
HOE-GRASS	8	5	8	8	9	8	8	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	E
POAST ULTRA	9	8	9	9	9	9	9	9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	0	0	E
SELECT	9	8	9	9	9	9	9	9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	0	0	E
VENTURE L	9	8	9	8	8	8	9	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9	0	0	E
[redacted]																											
BASAGRAN, BASAGRAN FORTE	0	0	0	0	0	0	0	0	7	9	5	9	8	9	7	7	8	6	9	5	2	2	8	0	5	7	G
BLAZER	0	0	0	0	0	0	0	0	7	6	2	8	7	9	8	9	9	7	7	7	6	5	2	2	6	6	F
CLASSIC	0	0	0	0	0	0	0	0	4	9	8	8	3	9	3	9	8	8	8	2	2	8	8	2	8	4	G
FIRSTRATE	0	0	0	0	0	0	0	0	7	9	9	?	2	9	2	2	9	9	9	?	2	?	?	2	7	7	E
PINNACLE	0	0	0	0	0	0	0	0	?	5	2	8	9	8	3	9	5	2	8	2	2	2	2	2	2	2	G
REFLEX	0	0	0	0	0	0	0	0	8	7	2	8	6	9	8	9	9	7	6	?	?	?	?	?	?	?	G
[redacted]																											
RELIANCE [2]	0	0	0	0	0	0	0	0	7	9	8	9	9	9	3	9	9	8	9	2	2	8	8	2	8	2	E[2]
[redacted]																											
PURSUIT	9	8	6	9	9	9	9	7	8	8	2	9	8	9	9	9	8	6	9	2	2	2	7	2	2	2	G
PURSUIT + FIRSTRATE	9	8	6	9	9	9	9	7	8	9	9	9	8	9	9	9	9	9	9	2	2	?	7	2	7	7	G
CLEAN SWEEP [1]	9	8	6	9	9	9	9	7	8	9	5	9	8	9	9	9	8	6	9	5	2	2	8	2	5	7	G
MERIDIAN PLUS [1]	8	6	8	9	9	8	9	?	7	7	5	9	8	9	9	9	8	6	9	?	?	?	8	5	5	?	G
VIPER [1]	8	6	8	8	8	8	9	?	9	7	4	9	8	9	9	9	9	7	8	?	5	?	?	5	8	?	G
[redacted]																											
ROUNDUP, VANTAGE [3]	9	9	9	9	9	9	9	9	8	9	8	8	9	9	9	9	9	8	9	7/8	5	8	8	9	8	9	E[3]

TABLE 17. Soybean Herbicide Weed Control Ratings

Trade Name	Grasses								Annual Broadleaves												Perennials							Crop Tolerance
	barnyard grass(a)	crabgrass	fall panicum	foxtail, giant	foxtail, green	foxtail, yellow	old witch grass(a)	proso millet	buckwheat, wild	cocklebur	fleabane, Canada	lady's thumb	lamb's-quarters(a)	mustards(a)	nightshades, annual (b)	pigweeds(a,b)	ragweed, common(a,b)	ragweed, giant	velvetleaf	bindweed, field	horsetail	milkweed	nutsedge	quackgrass	sow-thistle	thistle, Canada	
Postemergence tank-mixes																												
ASSURE II + BASAGRAN FORTE + PINNACLE	9	8	9	9	9	8	9	9	7	9	5	9	9	9	7	9	8	6	9	6	2	2	8	9	5	7	G
ASSURE II + PINNACLE	9	8	9	9	9	8	9	9	?	5	2	8	9	8	3	9	5	2	8	2	2	2	2	9	2	2	G
BLAZER + BASAGRAN FORTE	0	0	0	0	0	0	0	0	7	9	5	9	8	9	8	9	9	6	9	7	6	5	8	2	6	7	F
EXCEL SUPER + BASAGRAN FORTE	9	8	9	9	9	9	9	9	7	9	5	9	8	9	7	7	8	6	9	6	2	2	8	4	5	7	G
EXCEL SUPER + BASAGRAN FORTE + PINNACLE	9	8	9	9	9	9	9	9	7	9	5	9	9	9	7	9	8	6	9	6	2	2	8	4	5	7	G
EXCEL SUPER + PINNACLE	9	8	9	9	9	9	9	9	?	5	2	8	9	8	3	9	5	2	8	2	2	2	2	4	2	2	G
PINNACLE + BASAGRAN FORTE	0	0	0	0	0	0	0	0	7	9	5	9	8	9	7	7	8	6	9	6	2	2	8	1	5	7	G
PINNACLE + REFLEX	0	0	0	0	0	0	0	0	8	7	2	8	9	9	8	9	9	7	8	?	?	?	?	?	?	?	G
PURSUIT + REFLEX	9	8	6	9	9	9	9	7	8	8	2	9	8	9	9	9	8	7	9	2	2	2	7	2	2	2	G
VENTURE L + BASAGRAN	9	8	9	8	8	8	9	8	7	9	5	9	8	9	7	7	8	6	9	6	2	2	8	9	5	7	G
VENTURE 25G + BASAGRAN FORTE + PINNACLE	9	8	9	8	8	8	9	8	7	9	5	9	9	9	8	9	8	6	9	6	2	2	8	9	5	7	G
VENTURE 25G + PURSUIT	9	8	9	8	8	8	9	8	8	8	2	9	8	9	9	9	8	7	9	2	2	2	7	9	2	2	G
VENTURE 25G + REFLEX	9	8	9	8	8	8	9	8	8	7	2	8	6	9	8	9	9	7	6	?	?	?	?	9	?	?	G
Postemergence tank-mixes — herbicide tolerant varieties only																												
ASSURE II + RELIANCE[2]	9	8	9	9	9	7/8	9	9	7	9	8	9	9	9	3	9	9	8	9	5	3	8	8	9	8	8	G[2]

(a) Group 5 (triazine) resistant biotypes exist

(b) Group 2 resistant biotypes exist

? Insufficient information available to make a rating

[1] indicates herbicides sold as a co-pack under this trade name

[2] Use only on soybean varieties designated as "STS"

[3] Use only on certified soybean seed designated as "Roundup Ready" Soybean.

TABLE 18. Soybean Soil Applied Herbicide Tank Mixes

common name	Trade Name	grass herbicides						broadleaf herbicides									grass and broadleaf herbicides					
		AXIOM	DUAL MAGNUM	FRONTIER	BONANZA	RIVAL	TREFLAN	AFESIN	AFOLAN	LINURON	LOROX	FIRSTRATE	EVICT	LEXONE	SENCOR	PATORAN	BROADSTRIKE DUAL	BROADSTRIKE DUAL MAGNUM	BROADSTRIKE TREFLAN	PURSUIT	VALOR
glyphosate	CREDIT																			✓	
glyphosate	GLYPHOS		✓																	✓	
glyphosate	ROUNDUP		✓	✓									✓				✓	✓		✓	
glyphosate	ROUNDUP TRANSORB		✓														✓	✓		✓	
glyphosate	TOUCHDOWN		✓	✓													✓			✓	
glyphosate	VANTAGE																✓	✓		✓	
glyphosate	VANTAGE PLUS																✓	✓		✓	
paraquat	GRAMOXONE																			✓	
soil applied grass herbicides																					
metribuzin	AXIOM										✓				✓					✓	
s-metolachlor	DUAL MAGNUM							✓	✓	✓	✓			✓	✓	✓				✓	
dimethenamid	FRONTIER								✓		✓		✓	✓	✓					✓	
trifluralin	BONANZA													✓	✓					✓	
trifluralin	RIVAL													✓	✓					✓	
trifluralin	TREFLAN												✓	✓	✓					✓	
soil applied broadleaf herbicides																					
monolinuron	AFESIN		✓																	✓	
linuron	AFOLAN		✓	✓									✓							✓	
linuron	LINURON		✓										✓							✓	
linuron	LOROX	✓	✓	✓									✓	✓	✓					✓	
methyl	FIRSTRATE																✓			✓	
metribuzin	EVICT			✓			✓		✓	✓	✓						✓				
metribuzin	LEXONE		✓	✓	✓	✓	✓				✓									✓	
metribuzin	SENCOR	✓	✓	✓	✓	✓	✓				✓						✓			✓	
metobromuron	PATORAN		✓																		
soil applied grass and broadleaf herbicides																					
s-metolachlor	BROADSTRIKE DUAL											✓	✓								
flumetsulam/ s-metolachlor	BROADSTRIKE DUAL MAGNUM																				

TABLE 18. Soybean Soil Applied Herbicide Tank Mixes

common name	Trade Name	grass herbicides						broadleaf herbicides									grass and broadleaf herbicides					
		AXIOM	DUAL MAGNUM	FRONTIER	BONANZA	RIVAL	TREFLAN	AFESIN	AFOLAN	LINURON	LOROX	FIRSTRATE	EVICT	LEXONE	SENCOR	PATORAN	BROADSTRIKE DUAL	BROADSTRIKE DUAL MAGNUM	BROADSTRIKE TREFLAN	PURSUIT	VALOR
flumetsulam/ trifluralin	BROADSTRIKE TREFLAN																				
imazethapyr	PURSUIT	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓						
imazethapyr/ pendamethalin	VALOR																				

Registered 3-Herbicide Tank mixes

AXIOM + SENCOR + LOROX

DUAL MAGNUM, FRONTIER + LEXONE, SENCOR + AFOLAN, LOROX

ROUNDUP + DUAL MAGNUM, FRONTIER + LEXONE, SENCOR + AFOLAN, LOROX

ROUNDUP, GLYFOS, TOUCHDOWN + DUAL MAGNUM + SENCOR, LEXONE

ROUNDUP, GLYFOS, TOUCHDOWN + DUAL MAGNUM + PURSUIT

Co-Packs

BOUNDARY is a co-pack of DUAL MAGNUM and SENCOR

CONQUEST is a co-pack of PURSUIT and metribuzin

TABLE 19. Soybean Postemergence Herbicide Tank-Mixes

common name	TRADE NAME	grass herbicides						broadleaf herbicides							grass and broadleaf				
		ASSURE II	EXCEL SUPER	HOE-GRASS	POAST ULTRA	SELECT	VENTURE L	BASAGRAN	BASAGRAN FORTE	BLAZER	CLASSIC	FIRSTRATE	PINNACLE	REFLEX	RELIANCE	MERIDIAN	VIPER	PURSUIT	ROUNDUP [2]	VANTAGE [2]
ACCase inhibitor grass herbicides																				
quizalofop-p-ethyl	ASSURE II										✓		✓		✓					
fenoxaprop-p-ethyl	EXCEL SUPER								✓				✓							
diclofop-methyl	HOE-GRASS																			
sethoxdim	POAST ULTRA																			
clethodim	SELECT																			
fluazifop-p-butyl	VENTURE L							✓												
ALS inhibitor broadleaf herbicides																				
bentazon	BASAGRAN						✓			✓								✓		
bentazon	BASAGRAN FORTE		✓							✓			✓			✓		✓		
acifluorfen	BLAZER								✓											
chlorimuron-ethyl	CLASSIC	✓																		
chloransulam-methyl	FIRSTRATE																	✓		
thifensulfuron-methyl	PINNACLE	✓	✓						✓					✓						
fomasafen	REFLEX												✓				✓	✓		
chlorimuron-ethyl/thifensulfuron-methyl	RELIANCE [2]	✓																		
ALS inhibitor grass and broadleaf herbicides																				
imazamox	MERIDIAN [1]								✓											
imazamox	VIPER [1]													✓						
imazethapyr	PURSUIT							✓	✓			✓		✓						
EPSP inhibitor grass and broadleaf herbicides — herbicide tolerant varieties only																				
glyphosate	ROUNDUP [2]																	✓		
glyphosate	ROUNDUP TRANSORB [2]																			
glyphosate	VANTAGE [2]																			
glyphosate	VANTAGE PLUS [2]																			

Registered 3-Herbicide Tank mixes

ASSURE + BASAGRAN FORTE + PINNACLE

EXCEL SUPER + BASAGRAN FORTE + PINNACLE

VENTURE + BASAGRAN FORTE + PINNACLE

Co-Packs

[1] CLEANSWEEP is a co-pack of PURSUIT and BASAGRAN FORTE

[1] MERIDIAN PLUS is a co-pack of MERIDIAN and BASAGRAN FORTE

[1] VIPER is a co-pack of VIPER and REFLEX

[2] Use only on appropriate herbicide tolerant varieties

CHAPTER 12. OTHER FIELD CROPS

Soil Applied Treatments include

- **Preplant (PP)** — Also see Chapter 6, **SPECIAL METHODS: Preplant — Site Preparation** for details of products, rates and remarks.
- **Preplant Incorporated (PPI)** — Two incorporations at right angles operating at a depth of 10 cm using a double disk (7–10 km/hr) or vibrating shank S-tine cultivator (10–13 km/hr) are required unless otherwise stated. Cultivation-type equipment used for herbicide incorporation is known to spread perennial weeds to previously uninfested areas. Special attention should be directed toward machinery cleanliness, and/or treating fields with perennial weeds last.
- **Preemergence (PRE)** — Rainfall of 15–20 mm within 10 days after application is necessary to activate preemergence treatments. Shallow cultivation, rotary hoeing or harrowing will control weed escapes and improves herbicide activity in the absence of rainfall.

Postemergence (POST) — Leaf stage of the weeds is critical for good weed control. Smaller weeds are usually more sensitive to herbicide injury. Apply according to recommended leaf stages. Crop stage is important to optimize crop safety. Adjuvants will frequently improve the weed control when used as directed. Weather or other conditions may influence the optimum rate of adjuvant, see the product label for more details. Always use appropriate drift management technology.

Canola — Spring Planted

Active Ingredient TRADE NAME (Formulation)	RATE (active) PRODUCT PER HA	RATE PRODUCT PER ACRE	PRECAUTIONS (For more information, see Chapter 4: Notes on Herbicides and Chapter 5: Notes on Adjuvants.)
Canola — Soil Applied Grass Herbicides			
trifluralin TREFLAN EC (480 g/L) RIVAL (500 g/L) BONANZA 400 (400 g/L)	0.6 to 1.147 kg/ha 1.25 to 2.4 L/ha 1.2 to 2.3 L/ha 1.5 to 2.75 L/ha	 0.5 to 0.96 L/ac 0.4 to 0.76 L/ac 0.6 to 1.1 L/ac	▪ Apply PPI. ▪ Strongly absorbed to soil particles, negligible leaching.
Canola — Postemergence Grass Herbicides			
clethodim SELECT (240 g/L) plus surfactant AMIGO	0.03 to 0.045 kg/ha 0.13 to 0.19 L/ha 5 L/1000 L	 0.05 to 0.08 L/ac 5 L/1000 L	▪ Canola is tolerant at all growth stages. ▪ Apply to annual grasses and volunteer cereals in the 2–6 leaf stage of growth. ▪ Suppression of quackgrass when applied at the higher dose.
diclofop-methyl HOE-GRASS 284 (284 g/L)	0.7 to 0.8 kg/ha 2.5 to 2.8 L/ha	 1 to 1.12 L/ac	▪ Apply to annual grasses in the 1–4 leaf stage of growth. ▪ Canola is tolerant at all growth stages. ▪ Broadleaf herbicides must be applied at least 4 days before or after diclofop-methyl. Tank-mixtures with broadleaf herbicides will result in reduced weed control.
fenoxaprop-p-ethyl EXCEL SUPER (80.5 g/L)	0.054 kg/ha 0.67 L/ha	 0.27 L/ac	▪ Apply to annual grasses in the 1–6 leaf stage of growth. ▪ Canola is tolerant at all growth stages. ▪ This treatment will not control volunteer winter wheat.
fluazifop-p-butyl VENTURE L (125 g/L)	0.125 to 0.175 kg/ha 1.0 to 1.4 L/ha	 0.4 to 0.57 L/ac	▪ Apply to annual grasses in the 2–5 leaf stage of growth and 3–5 leaf stage of quackgrass. ▪ Use the 1.4 L/ha (0.57 L/ac) rate for a mixed stand of annual grasses and quackgrass. ▪ **Do NOT** apply VENTURE to canola later than the 5–leaf stage of crop growth.

Active Ingredient TRADE NAME (Formulation)	RATE (active) PRODUCT PER HA	RATE PRODUCT PER ACRE	PRECAUTIONS (For more information, see Chapter 4, Notes on Herbicides and Chapter 5, Notes on Adjuvants)
quizalofop-p-ethyl ASSURE II (96 g/L) plus oil concentrate CANPLUS 411 or SURE-MIX	0.036 to 0.072 kg/ha 0.375 to 0.75 L/ha 5 to 10 L/1000 L 5 L/1000 L	 0.15 to 0.3 L/ac 5 to 10 L/1000 L 5 L/1000 L	▪ Apply to annual grasses and volunteer cereals in the 2–leaf to tillering stage and to quackgrass in the 2–6 leaf stage of growth. ▪ Canola is tolerant at all growth stages. ▪ Use the higher rate of CANPLUS 411 when wild oats and quackgrass are the target weeds or under drought conditions. ▪ **Do NOT** apply to canola within 64 days of harvest. Use the higher rate of CANPLUS 411 when wild oats and quackgrass are the target weeds or under drought conditions. ▪ **Do NOT** apply to canola within 64 days of harvest.
sethoxydim POAST ULTRA (450 g/L) plus surfactant/solvent MERGE	0.15 to 0.2 kg/ha 0.32 to 0.47 L/ha 1 to 2 L/ha	 0.13 to 0.19 L/ac 0.4 to 0.8 L/ac	▪ Apply at 1–6 leaf stages of annual grasses ▪ Canola is tolerant at all growth stages.
sethoxydim POAST ULTRA (450 g/L) plus surfactant/solvent MERGE	0.5 kg/ha 1.1 L/ha 1 to 2 L/ha	 0.45 L/ac 0.4 to 0.8 L/ac	▪ Thorough preplant tillage will provide more uniform quackgrass emergence. ▪ Apply to quackgrass in the 1–3 leaf stage of growth.
Canola — Postemergence Broadleaf Herbicides			
clopyralid LONTREL 360 (360 g/L)	0.15 to 0.2 kg/ha 0.42 to 0.56 L/ha	 0.17 to 0.22 L/ac	▪ Apply 1 postemergence application per season at the 2–6 leaf stage of canola. ▪ Apply to Canada thistle at the rosette to pre-bud stage. ▪ Recommended for use **only** on the following cultivars: Cyclone, Ebony, Jewel, 46A65 and Hyola 401.
ethametsulfuron-methyl MUSTER (75 DF) plus surfactant AGRAL 90, AGSURF, CITOWETT PLUS, or COMPANION	11 g/ha 15 g/ha 2 L/1000 L	 6 g/ac 2 L/1000 L	▪ Apply when the wild mustard in the cotyledon to 6 leaf stages, before the crop begins to bolt. ▪ **Do NOT** plant to any crop except winter wheat in the year of treatment. ▪ **Do NOT** feed or graze treated crop within 60 days of application. ▪ **Do NOT** apply MUSTER tank-mix to Polish varieties of canola as crop injury may result.
Canola — Postemergence Grass and Broadleaf Herbicides			
fluazifop-p-butyl VENTURE L (125 g/L) plus ethametsulfuron-methyl MUSTER (75 DF)	0.125 to 0.175 kg/ha 1.0 to 1.4 L/ha 11 g/ha 15 g/ha	 0.4 to 0.57 L/ac 6 g/ac	▪ **Do NOT** apply VENTURE to canola later than the 5–leaf stage of crop growth. ▪ **Do NOT** apply MUSTER tank-mix to Polish varieties of canola as crop injury may result. ▪ Add MUSTER to the tank-mix first and agitate before adding VENTURE.
fluazifop-p-butyl VENTURE L (125 g/L) plus clopyralid LONTREL 360 (360 g/L)	0.125 to 0.175 kg/ha 1.0 to 1.4 L/ha 0.15 to 0.2 kg/ha 0.42 to 0.56 L/ha	 0.4 to 0.57 L/ac 0.17 to 0.22 L/a	▪ **Do NOT** apply VENTURE to canola later than the 5–leaf stage of crop growth. ▪ LONTREL is recommended for use ONLY on the following cultivars: Cyclone, Ebony, Jewel, 46A65 and Hyola 401. ▪ Add VENTURE to the tank first and agitate before adding LONTREL L.

sethoxydim POAST ULTRA (450 g/L) plus clopyralid LONTREL 360 (360 g/L) plus surfactant/solvent MERGE	0.15 to 0.2 kg/ha 0.32 to 0.47 L/ha 0.15 to 0.2 kg/ha 0.42 to 0.56 L/ha 0.75 to 1 L/ha	 0.13 to 0.19 L/ac 0.17 to 0.22 L/ac 0.3 to 0.4 L/ac	• Apply when canola is between the 2–6 leaf stages. • LONTREL is used on the following cultivars **only**: CYCLONE, EBONY, JEWEL, 46A65 and HYOLA 401. • Add ½ amount of water to tank, add the required amount of POAST ULTRA, and then add the required amount of LONTREL. Add MERGE last along with remaining amount of water to fill the tank.
sethoxydim POAST ULTRA (450 g/L) plus ethametsulfuron-methyl MUSTER (75 DF) plus surfactant/solvent MERGE	0.15 to 0.2 kg/ha 0.32 to 0.47 L/ha 11 g/ha 15 g/ha 0.75 to 1 L/ha	 0.13 to 0.19 L/ac 6 g/ac 0.3 to 0.4 L/ac	• Apply when canola is between the 2–leaf stage and bolting. • Add MUSTER to the tank first and agitate. Once MUSTER is in suspension add the required amount of POAST ULTRA, followed by the correct amount of MERGE.
sethoxydim POAST ULTRA (450 g/L) plus ethametsulfuron-methyl MUSTER (75 DF) plus clopyralid LONTREL 360 (360 g/L) plus surfactant/solvent MERGE	0.15 to 0.2 kg/ha 0.32 to 0.47 L/ha 11 g/ha 15 g/ha 0.15 kg/ha 0.42 L/ha 0.75 to 1 L/ha	 0.13 to 0.19 L/ac 6 g/ac 0.17 L/ac 0.3 to 0.4 L/ac	• Apply when canola is between the 2–leaf stage and bolting. • Add MUSTER to the tank first and agitate. Once MUSTER is in suspension add the required amount of POAST ULTRA, followed by the correct amount of MERGE.
Canola — Postemergence Grass and Broadleaf Herbicides (for use with herbicide tolerant varieties only)			
glufosinate ammonium LIBERTY 200 SN (200 g/L)	0.30 to 0.50 kg/ha 1.5 to 2.5 L/ha	0.6 to 1 L/ac	• LIBERTY 200SN can be applied from the cotyledon to the early bolting stage of canola. • **For use only with canola seed designated as "Liberty Link canola".** • Ammonium sulphate can be applied at 6 L/ha (2.4 L/ac)(liquid) or 3.3 kg/ha (1.3 kg/ac)(dry) for improved control of specific weeds. • **Do NOT** add oil or any other surfactants.
glufosinate ammonium LIBERTY 200 SN (200 g/L) plus fluazifop-p-butyl VENTURE 25G (25 DG) plus mineral oil/surfactant TURBOCHARGE	0.30 to 0.50 kg/ha 1.5 to 2.5 L/ha 0.175 kg/ha 0.7 kg/ha 5 L/1000 L	 0.6 to 1 L/ac 0.28 kg/ac 5 L/1000 L	• **For use only with canola seed designated as "Liberty Link canola".** • This tank-mix is recommended for improved quackgrass control. Quackgrass should be in the 1–4 leaf stage for maximum control and the minimum rate of LIBERTY 200SN should be 2.0 L/ha.
glyphosate ROUNDUP TRANSORB (360 g/L) VANTAGE PLUS (360 g/L)	0.297 to 0.45 kg/ha 0.825 to 1.25 L/ha 0.825 to 1.25 L/ha	 0.33 to 0.5 L/ac 0.33 to 0.5 L/ac	• **For use only with pedigreed (certified) canola seed designated as "Roundup Ready Canola".** • Apply up to the 6–leaf stage of the canola. A second application may be made for later flushes emerging after the initial application and for improved results on perennial weeds. • The higher rate should be used when weeds are larger, when weed pressure is high and for perennial weeds.

Active ingredient TRADE NAME Formulation	RATE (active) PRODUCT PER HA	RATE PRODUCT PER ACRE	PRECAUTIONS For more information see Chapter 4 Notes on Herbicides and Chapter 5 Notes on Adjuvants
imazethapyr	0.075 kg/ha		• For use on imazethapyr tolerant canola only.
PURSUIT (240 g/L)	0.312 L/ha	0.125 L/ac	• Apply early postemergence when the crop has at least one fully expanded leaf and before the weeds reach the 2 true leaf stage.
plus non-ionic surfactant	2.5 L/1000 L	2.5 L/1000 L	• PURSUIT will provide residual weed control from soil activity.
plus liquid fertilizer 10-34-0, 28-0-0 or 32-0-0	2 L/ha	0.8 L/ac	• Some rotational cropping restrictions apply.
Canola — Preharvest			
glyphosate*	0.9 kg/ha		• Apply in 50–100 L/ha (20–40 L/ac) water when the crop is at 30% grain moisture or less (consult label for visual indicators) apply 7–14 days prior to harvest and use ground application only
Glyphosate (360 g/L)	2.5 L/ha	1 L/ac	• **Do NOT** apply to seed crops
Canola — Harvest-Aid			
diquat	0.3 to 0.55 kg/ha		• Apply when crop is 60%–75% seed turn (green or brown) stage
REGLONE DESICCANT (240 g/L)	1.25 to 1.7 L/ha	0.6 to 1.1 L/ac	• Harvest no later than 14 days after herbicide application to avoid pod shatter • Use higher rate for heavy canopy
plus surfactant AGRAL 90 or AG-SURF	1 L/1000 L	1 L/1000 L	• Use minimum of 225 L/ha spray volume • DRIFT will injure adjacent crops or plants
• * Various formulations available see Table 1. See label for specific uses and rates.			
Flax			
Preplant (PP) — See Chapter 6, **Special Methods: Preplant — Site Preparation** for details of products, rates and remarks.			
Flax — Soil Applied Grass Herbicides			
triallate	1.7 to 2.2 kg/ha		• AVADEX can be applied before or after seeding for the control of wild oats.
AVADEX BW (400 g/L)	4.25 to 5.5 L/ha	1.7 to 2.2 L/ac	• Must be worked into the soil by 2 passes of cultivator.
Flax — Postemergence Grass Herbicides			
clethodim	0.03 to 0.09 kg/ha		• Apply when the annual grasses and volunteer cereals are in the 2–6 leaf stages.
SELECT (240 g/L)	0.13 to 0.38 L/ha	0.05 to 0.15 L/ac	• Apply to quackgrass in the 2–5 leaf stages. Use the higher rate for control of quackgrass.
plus surfactant AMIGO	5 to 10 L/1000 L	5 to 10 L/1000 L	• Flax is tolerant at any growth stage.
diclofop-methyl	0.71 to 0.795 kg/ha		• Apply in the spring when annual grasses are in the 1–5 leaf stages.
HOE-GRASS 284 (284 g/L)	2.5 to 2.8 L/ha	1 to 1.12 L/ac	• The higher rate (2.8 L/ha (1.12 L/ac)) must be used for control of wild oats in the 4–5 leaf stage.
fluazifop-p-butyl	0.075 kg/ha		• Apply at 2–4 leaf stage of annual grasses.
VENTURE L (125 g/L)	0.6 L/ha	0.24 L/ac	
fluazifop-p-butyl	0.25 kg/ha		• Apply at 3–5 leaf stage of quackgrass.
VENTURE L (125 g/L)	2 L/ha	0.8 L/ac	

quizalofop-p-ethyl ASSURE II (96 g/L) plus oil concentrate CANPLUS 411 or SURE-MIX	0.036 to 0.072 kg/ha 0.375 to 0.75 L/ha 5 to 10 L/1000 L 5 L/1000 L	 0.15 to 0.3 L/ac 5 to 10 L/1000 L 5 L/1000 L	• Apply to emerged annual grasses and volunteer cereals in the 2–leaf to tillering stage and to quackgrass in the 2–6 leaf stage of growth. • Use the 0.375 L/ha (0.15 L/ac) rate for control of volunteer corn, volunteer cereals and green foxtail. • The 0.5 L/ha (0.2 L/ac) rate provides suppression of quackgrass and will also control barnyard grass. • Use the 0.75 L/ha (0.3 L/ac) rate for control of quackgrass. • Use the higher rate of CANPLUS 411 when wild oats and quackgrass are the target weeds or under drought conditions. • **Do NOT** apply to flax within 82 days of harvest.
sethoxydim POAST ULTRA (450 g/L) plus oil concentrate ASSIST or surfactant/solvent MERGE	0.15 to 0.2 kg/ha 0.32 to 0.47 L/ha 2 L/ha 1 L/ha	 0.13 to 0.19 L/ac 0.8 L/ac 0.4 L/ac	• Treat the 1–6 leaf stage of annual grass. • For annual grasses and volunteer cereals. • **Do NOT** use on low-linolenic varieties. • Use the higher rate when volunteer cereals are present. • Use MERGE for conditions or weeds requiring medium to high rates of POAST ULTRA • Flax is tolerant at any stage of growth. • Apply using 110–200 L/ha of water (44–80 L/ac).
sethoxydim POAST ULTRA (450 g/L) plus surfactant/solvent MERGE	0.5 kg/ha 1.1 L/ha 1 to 2 L/ha	 0.45 L/ac 0.4 to 0.8 L/ac	• For quackgrass control. Thorough preplant tillage will ensure more uniform quackgrass emergence. • **Do NOT** use on low-linolenic varieties. • Apply using 100–200 L/ha of water (40–80 L/ac).
Flax — Postemergence Broadleaf Herbicides			
bentazon BASAGRAN (480 g/L) plus oil concentrate ASSIST	0.84 to 1.08 kg/ha 1.75 to 2.25 L/ha 2 L/ha	 0.7 to 0.9 L/ac 0.8 L/ac	• Apply when flax is 5 cm or higher and weeds are small and actively growing. • Top growth of nutsedge and Canada thistle is controlled and field bindweed may be suppressed. Two applications of 1.75 L/ha (0.7 L/ac) (0.84 kg active/ha), 10 days apart may be required. • A new flush of weeds may emerge after the first flush has been controlled. • Cool weather or concentrate to 1 L/ha (0.4 L/ac) under abnormally hot and humid weather conditions or temporary crop injury may occur.
bromoxynil/ MCPA BUCTRIL M ((1:1)560 g/L)	0.56 kg/ha 1 L/ha	0.4 L/ac	• Apply when the flax is 5–10 cm high before weeds have developed beyond the 4–leaf stage. • **Do NOT** use if the daytime temperature is over 29°C.
MCPA ESTEMINE MCPA (500 g/L)	0.42 to 0.55 kg/ha 0.84 to 1.1 L/ha	 0.34 to 0.44 L/ac	• Flax may be treated when 5 cm tall to bud stage. • Best weed control is obtained if the application is made when the weeds are small (approx. 5 cm tall).
Flax — Postemergence Grass and Broadleaf Herbicides			
clethodim SELECT (240 g/L) plus bromoxynil/ MCPA BUCTRIL M ((1:1)560 g/L) plus surfactant AMIGO	0.045 kg/ha 0.19 L/ha 0.56 kg/ha 1 L/ha 5 L/1000 L	 0.076 L/ac 0.4 L/ac 5 L/1000 L	• Apply when flax is 5–10 cm high and weeds are in the seedling stage for best results. • **Do NOT** use if daytime temperature is over 25°C.

Active ingredient TRADE NAME Formulation	RATE (active) PRODUCT PER HA	RATE PRODUCT PER ACRE	PRECAUTIONS For more information see Chapter 4 Notes on Herbicides and Chapter 5 Notes on Adjuvants
sethoxydim POAST ULTRA (450 g/L) plus bromoxynil/ MCPA BUCTRIL M ((1:1)560 g/L) surfactant/solvent MERGE	0.15 to 0.2 kg/ha 0.32 to 0.47 L/ha 0.56 kg/ha 1 L/ha 1 L/ha	 0.13 to 0.19 L/ac 0.4 L/ac 0.4 L/ac	▪ Apply when flax is 5–10 cm high before weeds have developed beyond the 4–leaf stage. ▪ **Do NOT** use if the daytime temperature is over 29°C. ▪ Apply using 100–200 L/ha of water (40–80 L/ac).
sethoxydim POAST ULTRA (450 g/L) plus MCPA MCPA AMINE (500 g/L) surfactant/solvent MERGE	0.15 to 0.2 kg/ha 0.32 to 0.47 L/ha 0.42 to 0.55 kg/ha 0.84 to 1.1 L/ha 1 L/ha	 0.13 to 0.19 L/ac 0.34 to 0.44 L/ac 0.4 L/ac	▪ Flax may be treated when 5 cm tall to bud stage. ▪ Best weed control is obtained if the application is made when the weeds are small (approximately 5 cm tall). ▪ Apply using 100–200 L/ha of water (40–80 L/ac).
Flax — Preharvest			
diquat REGLONE DESICCANT (240 g/L) plus AGRAL 90	0.3 to 0.408 kg/ha 1.25 to 1.7 L/ha 1 L/1000 L	 0.5 to 0.68 L/ac 1 L/1000 L	▪ Apply by aircraft in at least 20 L of water/ha (8 L/ac) when the crop is at 75% boll turn stage. ▪ **Do NOT** apply to immature crop. ▪ This application reduces dry down time and eliminates the need for swathing.
glyphosate* glyphosate (360 g/L)	0.89 kg/ha 2.5 L/ha	 1 L/ac	▪ Apply in 50–100 L/ha (20–40 L/ac) water when the crop is at 30% grain moisture or less (Consult label for visual indicators). ▪ Apply at least 7 days prior to harvest. ▪ DO NOT apply to seed crops. ▪ DO NOT apply with aircraft. ▪ Touchdown is not registered Preharvest in Flax

* Various formulations available see Table 1. See label for specific uses and rates.

Peanuts

Preplant (PP) — See Chapter 6, **Special Methods, Preplant – Site Preparation** for details of products, rates and remarks.

Peanuts — Postemergence Broadleaf Herbicides

bentazon BASAGRAN (480 g/L) plus oil concentrate ASSIST	1.08 kg/ha 2.25 L/ha 2 L/ha	 0.9 L/ac 0.8 L/ac	▪ Apply when peanuts are in the unifoliate to 4th trifoliate leaf stage and when weeds are small and actively growing. ▪ Many annual broadleaf weeds including velvetleaf (15 cm/up to 6 leaf), smartweed (20 cm/up to 10 leaf) and cocklebur (30 cm/up to 10 leaf) are controlled. ▪ Top growth of Canada thistle and yellow nutsedge is controlled and field bindweed may be suppressed but 2 applications of BASAGRAN at 1.75 L/ha (0.7 L/ac) 10 days apart may be required. ▪ A new flush of weeds may emerge after the first flush has been controlled. ▪ Temporary crop injury may occur under abnormally cool or hot, humid conditions. Reduce rate of oil concentrate to 1 L/ha (0.4 L/ac) when those conditions occur. Cool weather or drought may delay or reduce control.

Sunflowers

Cultural control of weeds in sunflowers can be used successfully, but only if weeds are also controlled in other crops in the rotation. There are several tillage options in the sunflower crop.

Preplant tillage can control 1 or 2 flushes of early germinating weeds. Plant sunflowers immediately after the last tillage operation.

A rotary hoe set to cultivate shallow can be effective in removing annual weeds that are just emerging. It is not very useful for controlling well-rooted seedlings.

Spring tooth harrows can be used to control small weeds when sunflowers are in the 4–6 leaf stages. There will be some damage to sunflowers and larger weeds will not be well controlled.

One or 2 cultivations with a row crop cultivator are the most common form of cultural control. Sunflowers have to be big enough to withstand burial. Lateral roots on sunflowers are shallow, so avoid cultivating too deep or too close to plants.

Sunflowers — Soil Applied Grass Herbicides			
EPTC	3.4 kg/ha		▪ Apply PPI.
EPTAM (800 g/L)	4.25 L/ha	1.7 L/ac	▪ **Do NOT** use on light sandy soils with less than 3% organic matter.
trifluralin	0.6 to 1.155 kg/ha		▪ Apply PPI
TREFLAN EC (480 g/L)	1.25 to 2.4 L/ha	0.5 to 0.96 L/ac	
RIVAL (500 g/L)	1.2 to 2.3 L/ha	0.48 to 0.92 L/ac	
Sunflowers — Postemergence Grass Herbicides			
clethodim	0.03 to 0.09 kg/ha		▪ Apply when the annual grasses and volunteer cereals are in the 2–6 leaf stages.
SELECT (240 g/L)	0.13 to 0.38 L/ha	0.05 to 0.15 L/ac	▪ Apply to quackgrass in the 2–5 leaf stages. Use the higher rate for control of quackgrass.
plus surfactant			▪ Allow 72 days between application and harvest.
AMIGO	5 to 10 L/1000 L	5 to 10 L/1000 L	
fluazifop-p-butyl	0.075 kg/ha		▪ This rate is for control of volunteer corn only
VENTURE L (125 g/L)	0.6 kg/ha	0.24 L/ac	▪ Apply at 2–5 leaf stage of the volunteer corn.
fluazifop-p-butyl	0.125 to 0.18 kg/ha		▪ Apply at 2–4 leaf stage of annual grasses and at 3–5 leaf stage quackgrass.
VENTURE L (125 g/L)	1.0 to 1.4 L/ha	0.4 to 0.57 L/ac	
Sunflowers — Harvest-Aid			
diquat	0.3 kg/ha		▪ REGLONE may be used to reduce the period of time from maturity to harvest, to speed up harvesting, and decrease seed moisture at harvest.
REGLONE	1.25 L/ha	0.5 L/ac	▪ Apply in 45 L/ha (18 L/ac) water with fixed wing aircraft.
DESICCANT(240 g/L)			▪ Spray when seeds reach maturity (20%–50% seed moisture).
plus surfactant	1 L/1000 L	1 L/1000 L	▪ Combine 15–20 days after spraying.
AGRAL 90			▪ Beware of drift to adjacent crops or plants.
			▪ See "Notes on Chemicals" for comments on aerial application.

Tobacco

Preplant (PP) — See Chapter 6, **Special Methods, Preplant — Site Preparation** for details of products, rates and remarks.

pebulate TILLAM (720 g/L)	4.53 to 5.54 kg/ha 6.25 to 7.75 L/ha	 2.5 to 3.1 L/ac	• Apply PPI. • Apply to dry soil and incorporate immediately. • Delay transplanting for 4 days after application. • Use the low rate on sandy soils and the higher rate on loamy sand soils and when applying prior to row fumigation. • For use on flue-cured tobacco and cigarette burley tobacco

Apply in 150–300 L/ha (60–120 L/ac) water

fluazifop-p-butyl VENTURE L(125 g/L)	0.075 to 0.125 kg/ha 0.6 to 1 L/ha	 0.24 to 0.4 L/ac	• May be applied up to 45 days to harvest.
napropamide DEVRINOL DF (50 DF)	1.125 to 2.25 kg/ha 2.25 to 4.5 kg/ha	 0.9 to 1.8 kg/ac	• Apply immediately following transplanting in a 25–30 cm band over the transplants. • Use lower rates on lighter soils. • For best results, lightly incorporate or apply irrigation if rainfall does not occur within 2 days of application. • After harvest, soil should be worked at right angles to the rows to prevent injury to succeeding crops. Small grains may be seeded in the fall to prevent soil erosion. These grains may be stunted but not otherwise affected.

Weed control ratings are given as 0–9 where 0 indicates no control and 9 indicates 90%–100% control under ideal conditions.
Ratings are subjective values based on best available information and give general comparisons based on use as descibed in this guide.
Under unfavorable conditions (eg., too dry, too wet, too cold, or poor application) the herbicides may not be as effective as indicated.
Ratings may vary with weed and crop stage and with the timing and rates of the product(s) being used.
Ratings in **BOLD** indicate the weed is listed on the product label for control or suppression.
Please see product label for more information on registered weed species, product uses and precautions.

TABLE 20. Canola, Flax, Sunflowers Herbicide Weed Control Ratings

	Crop			Annual Grasses												Annual Broadleaves											Perennials						
Trade Name	canola	flax	Sunflowers	barnyard grass	crabgrass	fall panicum	foxtail, giant	foxtail, green	foxtail, yellow	old witch grass	proso millet	wild oats	vol. corn	vol. wheat	vol. barley	buckwheat, wild	cocklebur	fleabane, Canada	lady's thumb	lamb's-quarters	wild mustard	nightshades, annual	pigweed	ragweed, common	ragweed, giant	velvetleaf	field bindweed	horsetail	milkweed	nutsedge	quackgrass	sow-thistle	thistle, Canada
AVADEX		✓		?	?	?	?	?	?	?	?	**8**	?	?	?	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
EPTAM			✓	**9**	**9**	**9**	**9**	**9**	**9**	**9**	7	**8**	?	?	?	4	2	0	7	7	5	7	7	5	3	5	?	?	?	8	5	?	?
TREFLAN, BONANZA, RIVAL	✓		✓	**9**	**9**	9	9	**9**	**9**	9	7	**8**	?	?	?	**5**	2	0	2	**8**	2	2	**8**	2	2	2	2	2	2	2	2	2	2
ASSURE II	✓	✓		**9**	8	9	9	**9**	8	9	9	?	9	9	9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**9**	0	0
EXCEL SUPER	✓			**9**	**8**	**9**	9	**9**	**9**	**9**	**9**	?	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0
HOE-GRASS	✓	✓		**8**	**5**	**8**	8	**9**	**8**	**8**	3	**9**	**8**	?	?	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0
POAST ULTRA	✓	✓		**9**	**8**	**9**	**9**	**9**	**9**	**9**	**9**	**8**	**8**	7	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**6**	0	0
SELECT	✓	✓	✓	**9**	**8**	**9**	9	**9**	**9**	**9**	**9**	?	?	?	?	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	0	0
VENTURE L	✓		✓	**9**	8	**9**	8	**8**	**8**	9	**8**	**9**	**9**	**9**	**9**	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**9**	0	0
BASAGRAN		✓		0	0	0	0	0	0	0	0	0	0	0	0	7	**9**	5	**9**	**8**	**9**	7	7	**8**	6	**9**	6	2	2	**8**	0	6	7
BUCTRIL M		✓		0	0	0	0	0	0	0	0	0	0	0	0	**9**	**8**	?	**9**	**9**	**9**	**9**	**8**	**9**	?	**9**	7	7	0	0	0	7	7
LONTREL	✓			0	0	0	0	0	0	0	0	0	0	0	0	**8**	?	?	3	5	0	?	5	8	?	?	3	?	?	0	0	**8**	**8**
MCPA		✓		0	0	0	0	0	0	0	0	0	0	0	0	2	7	?	**2**	**9**	**9**	?	**9**	**9**	?	**8**	7	8	0	0	0	7	7
MUSTER	✓			0	0	0	0	0	0	0	0	0	0	0	0	2	0	?	0	2	**9**	2	**8**	2	1	0	0	0	0	0	0	0	0
LIBERTY[1]	✓			**9**	**9**	**9**	**9**	**9**	**8**	**9**	**9**	**8**	?	?	?	**8**	**9**	7	**8**	**9**	**9**	**9**	**9**	**9**	?	**8**	**6**	6	?	6	**6**	**8**	7
LIBERTY[1] + VENTURE 25G	✓			**9**	**9**	**9**	**9**	**9**	**9**	**9**	**9**	**9**	**9**	**9**	**9**	**8**	**9**	7	**8**	**9**	**9**	**9**	**9**	**9**	?	**8**	**6**	7	?	6	**9**	**8**	7
PURSUIT[2]	✓			**8**	7	7	9	**9**	**9**	8	7	**8**	?	?	?	8	7	2	9	**9**	9	**9**	**9**	**8**	6	**9**	2	2	2	4	5	2	2

TABLE 20: Canola, Flax, Sunflowers Herbicide Weed Control Ratings

	Crop			Annual Grasses												Annual Broadleaves												Perennials						
Trade Name	canola	flax	Sunflowers	barnyard grass	crabgrass	fall panicum	foxtail, giant	foxtail, green	foxtail, yellow	wild oat grass	proso millet	wild oats	vol. corn	vol. wheat	vol. barley	buckwheat, wild	cocklebur	fleabane, Canada	lady's thumb	lamb's-quarters	wild mustard	nightshades, annual	pigweed	ragweed, common	ragweed, giant	velvetleaf	field bindweed	horsetail	milkweed	nutsedge	quackgrass	sow-thistle	thistle, Canada
ROUNDUP TRANSORB[3] VANTAGE PLUS[3]	✓			9	9	9	9	9	9	9	9	9	9	9	9	8	9	8	8	9	9	9	9	9	7/8	9	8	2	7/8	?	9	8	8
POAST ULTRA + BUCTRIL M		✓		9	8	9	9	9	9	9	9	8	8	7	7	9	8	?	9	9	9	9	8	9	?	9	7	7	?	?	6	7	7
POAST ULTRA + LONTREL	✓			9	8	9	9	9	9	9	9	8	8	7	7	8	?	?	3	5	0	?	5	8	?	?	3	?	?	0	6	8	8
POAST ULTRA + MCPA *		✓		9	8	9	9	9	9	9	9	8	8	7	7	2	7	?	2	9	9	?	9	9	?	8	7	8	0	0	6	7	7
POAST ULTRA + MUSTER	✓			9	8	9	9	9	9	9	9	8	8	7	7	2	0	?	0	2	9	2	8	2	?	0	0	0	0	0	6	0	0
SELECT + BUCTRIL M		✓		9	8	9	9	9	9	9	9	?	?	?	?	9	8	?	9	9	9	9	8	9	?	9	7	7	?	?	7	7	7
VENTURE + LONTREL	✓			9	8	9	8	8	8	9	8	9	9	9	9	8	?	?	3	5	0	?	5	8	?	?	3	?	?	0	9	8	8
VENTURE + MUSTER	✓			9	8	9	8	8	8	9	8	9	9	9	9	2	0	?	0	2	9	2	8	2	?	0	0	0	0	0	9	0	0

* Various formulations available, see Table 1. See label for specific uses and rates.

? Insufficient information available to make a rating

[1] Use only on crops planted with certified canola seed designated as "Liberty Link" Canola

[2] Use only on crops planted with certified canola seed designated as "Pursuit Tolerant" Canola.

[3] Use only on crops planted with certified canola seed designated as "Roundup Ready" Canola.

CHAPTER 13. VEGETABLE CROPS

More that 50 vegetable crops are grown commercially in Ontario. Some are seeded, some transplanted, some are annuals, and other crops are perennial, presenting a very diverse group of situations to manage weeds. Weed management involves all aspects of weed control in vegetable crops including herbicides, cultivation, hoeing, mulches, weed prevention, etc.

Perennial weeds are often a more severe problem in perennial horticultural crops such as asparagus. Quackgrass, bindweed, thistles, horsetail, dandelions, etc. should be controlled before these crops are planted.

Recommendations for snap beans or sweet corn will be found in the field crop section (Chapter 7, Beans, and Chapter 9, Corn, Field & Sweet) because they are similar to those for field corn and field beans. Differences are noted where necessary.

Treatments listed for horticultural crops in the publication are based on extensive research trials. Herbicides should not be used in cold frames or greenhouses unless specifically recommended.

Horticultural crops are often high value crops. Weed competition is costly. Improper application of herbicides also can be costly. Sprayers used for hormone type herbicides (2,4-D, etc.) should not be used to apply insecticides, fungicides or other herbicides on susceptible horticultural crops.

WEED CONTROL IN GARDENS

Many garden plants can be killed or damaged by the chemicals used to kill weeds. The frequent use of a hoe, or other shallow cultivation, is the most practical method of controlling weeds in gardens. Most annual weeds can be killed with one or 2 cultivations. Perennial weeds can be controlled by any kind of cultivation that removes all top growth at frequent intervals. After the food stored in the roots has been used, the weeds will die.

When it is possible to apply the chemical to one kind of garden plant, without danger of spray or dust drifting onto susceptible garden plants, one of the chemicals recommended in this publication may be used. (Check list below.) Granular formulations can be applied using a jam jar with a perforated top. This "salt shaker" method, after a little practice, is effective and quick. A small compressed air sprayer can be used to apply any liquid or wettable powder that is mixed with water. It is important that the correct amount be applied. One way of ensuring accuracy is to fill the garden sprayer with water to a mark — apply the spray to 100 m² taking care to apply it as evenly as possible, and then measure the amount of water used. Add the chemical recommended in the publication to this amount of water for each 100 m² treated.

As a guide in converting the recommended rate of any chemical to the amount required for a small area, 32 g per 100 m² is approximately equal to 3.25 kg/ha. For liquid measure, 2 level tbsp. is approximately 28 mL. One L of spray mixture per 100 m² is equal to 100 L/ha.

The herbicides listed under each crop are available for farm, custom spraying, and industrial use. The Ontario *Pesticides Act* restricts the sale of herbicides to the home gardener to those with a domestic label.

PREPLANT WEED AND COVER CROP CONTROL

Cover crops and emerged weeds should be controlled before seeding or transplanting vegetable crops. This can be done with glyphosate (0.75 to 3.5 L/ha) a translocated systemic herbicide, with paraquat (GRAMOXONE) or diquat (REGLONE) at 3.0 to 5.5 L/ha (1.2 to 2.2 L/ac), both contact, non-systemic herbicides or with glufosinate ammonium (IGNITE) at 2.7 to 5.0 L/ha (1.08 to 2 L/ac), a minimal translocation, mostly contact, non-systemic herbicide. All 4 herbicides are non-residual. Glyphosate (ROUNDUP or TOUCHDOWN) can be used before planting any vegetable crops. Paraquat (GRAMOXONE) or diquat (REGLONE) are registered for preplant use on beans, beets, carrots, cole crops, onions, peas, potatoes, sweet corn and rutabagas. Glufosinate ammonium (IGNITE) is registered for preplant use on carrot, lettuce and onions only. See Table 6, *Herbicides Available for Preplant Site Preparation*.

The **Stale Seedbed Technique** involves preparing a seedbed early in the growing season, and controlling emerged weeds several weeks later with glyphosate, GRAMOXONE, REGLONE or IGNITE. Seeding or transplanting vegetable crops is done trying to disturb the soil as little as possible to delay the emergence of new crop of weeds. This allows the crop to establish well before the next flush of weeds.

Alternatively, a grower may choose to kill the cover crop or/and emerged weeds just before planting the vegetable crop and either till the area or leave seedbed untilled.

Inter-row weeding with a contact herbicide such as paraquat (3 to 5.5 L/ha (1.2 to 2.2 L/ac) (product) in 250–1000 L/ha (100–400 L/ac) water) can be used as a rescue operation where other methods of weed control have failed. The herbicide is directed between the crop rows onto the emerged weeds. Use special low pressure (7–15 kPa) applicators such as dribble bars or vibra jets equipped with shields to prevent wetting the crop. This technique of weeding with paraquat is registered for use on beans, beets, carrots, cole crops, cucumbers, lettuce, onions, potatoes, sweet corn and tomatoes. See Chapter 6, *Interrow Chemical Weeding*.

PREPLANTING (PP) TREATMENTS

Preplanting treatments are applied before the crop is sown or planted. Some of these herbicides kill seedlings soon after germination while others also kill weed seeds. Most herbicides used for these treatments must be thoroughly incorporated in the soil by cultivation soon after application. Check the label.

SELECTIVE PREEMERGENCE (PRE or PPI) HERBICIDES

These materials prevent emergence of many weed seedlings without reducing crop stand. This type of material should be applied immediately after seeding or at least before the emergence of the crop. If these materials are applied after weeds have emerged, kill is usually poor. Best results are obtained with this method when conditions for weed seed germination are good.

SELECTIVE POSTEMERGENCE (POST) HERBICIDES

These chemicals are applied after the crop plants have sprouted, or after the crop has been transplanted. Applied as directed, the weeds can be killed without injury to the crop. The weeds should be small for best results.

Asparagus

Site Preparation Before Planting — See Chapter 6, Special Methods of Weed Control

PREPLANT INCORPORATED (PPI) — Two incorporations at right angles operating at a depth of 10 cm using a double disk (7–10 km/hr) or vibrating shank S-tine cultivator (10 to 13 km/hr) are required unless otherwise stated. Cultivation-type equipment used for herbicide incorporation is known to spread perennial weeds to previously uninfested areas. Special attention should be directed toward machinery cleanliness, and/or treating fields with perennial weeds last.

PREEMERGENCE (PRE) — Rainfall at 15–20 mm within 7–10 days after application is necessary to activate preemergence treatments. Shallow cultivation, rotary hoeing or harrowing will control weed escapes and improve herbicide activity in the absence of rainfall.

Active ingredient TRADE NAME (Formulation)	RATE (active) PRODUCT PER HA	RATE PRODUCT PER ACRE	PRECAUTIONS (For more information see "Notes on Chemicals" section)
Before Emergence of Direct Seeded Asparagus — Postemergence Grass & Broadleaf Herbicides			
glufosinate ammonium IGNITE (150 g/L)	0.405 to 0.75 kg/ha 2.7 to 5 L/ha	 1.08 to 2 L/ac	• Apply in 110–330 L/ha (44–132 L/ac) water. • Spray uniformly on emerged weeds prior to emergence of the crop. • Weeds that have not emerged will not be controlled.
paraquat GRAMOXONE (200 g/L) followed by napropamide DEVRINOL DF (50 DF)	0.6 to 1.1 kg/ha 3 to 5.5 L/ha 2.25 to 4.5 kg/ha 4.5 to 9 kg/ha	 1.2 to 2.2 L/ac 1.8 to 3.6 kg/ac	• Apply in 300–1100 L/ha (120–440 L/ac) water. • Spray GRAMOXONE as a "chemical mower" to kill emerged seedling weeds before the first asparagus seedlings are beginning to emerge. • Apply DEVRINOL as a separate application just before a second flush of weeds emerge.
terbacil SINBAR (80 WP)	0.3 kg/ha 0.38 kg/ha	 0.15 kg/ac	• PRE — Apply as a broadcast treatment within 2 days of seeding. • Plant asparagus seed to a depth of 4 cm in coarse (sandy) soils, or 2.5 cm deep in fine (clay) soils into newly cultivated fields.

Direct Seeded Asparagus — Postemergence Grass Herbicides

POSTEMERGENCE — Leaf stage of the weeds is critical for good weed control. Smaller weeds are generally easier to kill but there needs to be enough leaf surface to intercept the herbicide. Apply according to recommended leaf stages. Crop stage is important to optimize crop safety. Adjuvants will frequently improve the weed control when used as directed. Weather or other conditions may influence the optimum rate of adjuvant, see the product label for more details. Always use appropriate drift management technology.

fluazifop-p-butyl VENTURE L (125 g/L)	0.075 to 0.25 kg/ha 0.6 to 2 L/ha	 0.24 to 0.8 L/ac	• Apply to actively growing grasses prior to tillering. • Apply at 0.6 L/ha (0.24 L/ac) at 2–5 leaf stage of annual grasses (2–4 leaf for foxtails). • Apply at 0.8 L/ha (0.32 L/ac) at 2–5 leaf stage of volunteer wheat and barley. • Apply at 2 L/ha (0.8 L/ac) at 3–5 leaf stage of quackgrass & wirestem muhly. • Thorough preplant tillage, fragmenting quackgrass rhizomes improves control. • **Do NOT** cultivate between rows until 5 days after application.
sethoxydim POAST ULTRA (450 g/L) plus surfactant/solvent MERGE	0.15 to 0.5 kg/ha 0.32 to 1.1 L/ha 1 to 2 L/ha	 0.13 to 0.45 L/ac 0.4 to 0.8 L/ac	• Apply to actively growing grasses. • For annual grass, use 0.32 L/ha. Apply at the 1–6 leaf stage (2–5 is optimum). • For volunteer grains, use 0.47 L/ha. Apply at the 1–6 leaf stage (2–5 is optimum). • For quackgrass, use 1.1 L/ha. Apply up to the 3–leaf stage. Thorough preplant tillage will ensure more uniform quackgrass emergence. Cultivate after 7 days in wide row crops. Use the high rate of MERGE for quackgrass. • Use 100–200 L water/ha (40–80 L water/ac). • Grasses emerging after application will not be controlled. • Spray tips angled forward 45° will give better coverage. • **Do NOT** use flood jet or hollow cone nozzles. • **Do NOT** apply if rain is expected within 1 hr. after application. • Preharvest interval is 40 days.
1st Year Crown-Established Asparagus — Soil Applied Grass & Broadleaf Herbicides			
napropamide DEVRINOL DF (50 DF)	2.25 to 4.5 kg/ha 4.5 to 9 kg/ha	 1.8 to 3.6 kg/ac	• PPI — Incorporation by irrigation or rainfall is essential. • Treat at planting time, or soon after planting before weed seedlings appear. • Use lower rate on sandy soils and the higher rate on clay soils.
1st Year Crown-Established Asparagus — Postemergence Grass Herbicides			
fluazifop-p-butyl VENTURE L (125 g/L)	0.075 to 0.25 kg/ha 0.6 to 2 L/ha	 0.24 to 0.8 L/ac	• Apply to actively growing grasses prior to tillering. • Apply at 0.6 L/ha (0.24 L/ac) at 2–5 leaf stage of annual grasses (2–4 leaf for foxtails). • Apply at 0.8 L/ha (0.32 L/ac) at 2–5 leaf stage of volunteer wheat and barley. • Apply at 2 L/ha (0.8 L/ac) at 3–5 leaf stage of quackgrass & wirestem muhly. • Thorough preplant tillage, fragmenting quackgrass rhizomes improves control. • **Do NOT** cultivate between rows until 5 days after application.
sethoxydim POAST ULTRA (450 g/L) plus surfactant/solvent MERGE	0.15 to 0.5 kg/ha 0.32 to 1.1 L/ha 1 to 2 L/ha	 0.13 to 0.45 L/ac 0.4 to 0.8 L/ac	• Apply to actively growing grasses. • For annual grass, use 0.32 L/ha. Apply at the 1–6 leaf stage (2–5 is optimum). • For volunteer grains, use 0.47 L/ha. Apply at the 1–6 leaf stage (2–5 is optimum). • For quackgrass, use 1.1 L/ha. Apply up to the 3–leaf stage. Thorough preplant tillage will ensure more uniform quackgrass emergence. Cultivate after 7 days in wide row crops. Use the high rate of MERGE for quackgrass. • Use 100–200 L water/ha (40–80 L water/ac). • Grasses emerging after application will not be controlled. • Spray tips angled forward 45° will give better coverage. • **Do NOT** use flood jet or hollow cone nozzles. • **Do NOT** apply if rain is expected within 1 hr. after application. • Preharvest interval is 40 days.

Active Ingredient TRADE NAME (Formulation)	RATE (active) PRODUCT PER HA	RATE PRODUCT PER ACRE	PRECAUTIONS (For more information see "Notes on Chemicals" section
2nd Year & Established Asparagus — Soil Applied Grass and Broadleaf Herbicides			
diuron KARMEX (80 DF)	1.75 to 2.25 kg/ha 2.19 to 2.81 kg/ha	 0.88 to 1.12 kg/ac	• PRE — Disk before any shoots appear in the spring on established plantings. • A second application may be made after the postharvest disking. • Use lower rates for lighter soils. • Rates are given for overall sprays; reduce proportionately if only rows are sprayed. • **Do NOT** use on fields that will be removed after harvest.
linuron LOROX DF (50 DF) AFOLAN F (480 g/L) LINURON 480 (480 g/L)	1.75 to 2.25 kg/ha 3.5 to 4.5 kg/ha 3.64 to 4.69 L/ha 3.64 to 4.69 L/ha	 1.4 to 1.8 kg/ac 1.46 to 1.88 L/ac 1.46 to 1.88 L/ac	• PRE — Disk before any shoots appear in the spring on established plantings. • A second application may be made after the postharvest disking. • Use lower rates for lighter soils. • Rates are given for overall sprays; reduce proportionately if only rows are sprayed.
metribuzin SENCOR 75 DF (75 WG) LEXONE DF (75 DF) EVICT SOLUPAK 75 DF (75 DF)	1.1 to 2.25 kg/ha 1.46 to 3 kg/ha 1.46 to 3 kg/ha 1.46 to 3 kg/ha	 0.58 to 1.2 kg/ac 0.58 to 1.2 kg/ac 0.58 to 1.2 kg/ac	• PRE — Disk before any shoots appear in the spring on established plantings. • A second application may be made after the postharvest disking. • Use lower rates for lighter soils. • Rates are given for overall sprays; reduce proportionately if only rows are sprayed.
simazine PRINCEP NINE-T (90 WG) plus napropamide DEVRINOL 50W (50 WP)	1.1 to 2.2 kg/ha 1.2 to 2.4 kg/ha 4.5 to 6.7 kg/ha 9 to 13.4 kg/ha	 0.5 to 1 kg/ac 3.6 to 5.36 kg/ac	• PRE — Disk before any shoots appear in the spring on established plantings. • Use lower rates for lighter soils. • Make only one application per season. • **Do NOT** apply within 6 days of harvest.
simazine PRINCEP NINE-T (90WG) SIMADEX (500 g/L) SIMAZINE 480 (480 g/L)	2.2 to 3.4 kg/ha 2.5 to 3.75 kg/ha 4.5 to 6.7 L/ha 4.7 to 7 L/ha	 1 to 1.5 kg/ac 1.8 to 2.68 L/ac 1.88 to 2.8 L/ac	• PRE — Apply preemergence to crop, 7 days before first cutting. • Use **ONLY** on established plantings 3 years or older. • A second application may be made after the postharvest disking. • Use lower rates for lighter soils. • Rates are given for overall sprays; reduce proportionately if only rows are sprayed • **Do NOT** use on fields that will be removed after harvest.
terbacil SINBAR (80 WP)	0.3 kg/ha 0.375 kg/ha	 0.15 kg/ac	• PRE — Apply before spears emerge, or immediately after clean cutting. • Apply **ONLY** on established asparagus beds. • Apply **ONLY** once throughout the entire growing season. • Apply before weeds emerge, or to small, actively growing weeds (up to 5 cm). • **Do NOT** use on soils containing less than 1% organic matter, or where subsoil or roots are exposed. • **Do NOT** use on plants that are weak or diseased, or lacking in vigor (slow growing). • **Do NOT** harvest within 5 days of treatment. • Treated areas may be replanted to asparagus the following year after application. • **Do NOT** plant any other crop for 2 years.

2nd Year & Established Asparagus — Postemergence Herbicides			
sethoxydim POAST ULTRA (450 g/L) plus surfactant/solvent	0.15 to 0.5 kg/ha 0.32 to 1.1 L/ha	 0.13 to 0.45 L/ac	▪ Apply to actively growing grasses. ▪ For annual grass, use 0.32 L/ha. Apply at the 1–6 leaf stage (2–5 is optimum). ▪ For volunteer grains, use 0.47 L/ha. Apply at the 1–6 leaf stage (2–5 is optimum).
MERGE	1 to 2 L/ha	0.4 to 0.8 L/ac	▪ For quackgrass, use 1.1 L/ha. Apply up to the 3 leaf stage. Thorough preplant tillage will ensure more uniform quackgrass emergence. Cultivate after 7 days in wide row crops. Use the high rate of MERGE for quackgrass. ▪ Use 100–200 L water/ha (40–80 L water/ac). ▪ Grasses emerging after application will not be controlled. ▪ Spray tips angled forward 45° will give better coverage. ▪ **Do NOT** use flood jet or hollow cone nozzles. ▪ **Do NOT** apply if rain is expected within 1 hr. after application. ▪ Preharvest interval is 40 days.
2nd Year & Established Asparagus — Postemergence Broadleaf and Grass Herbicides			
glufosinate ammonium IGNITE (150 g/L)	0.405 to 0.75 kg/ha 2.7 to 5 L/ha	 1.08 to 2 L/ac	▪ To control fall-seeded rye and emerged weeds. ▪ Apply in the spring before spears emerge. ▪ Apply in 110–330 L/ha (44–132 L/ac) water. ▪ Weeds that have not emerged will not be controlled.
glyphosate ROUNDUP (356 g/L)	0.45 to 0.89 kg/ha 1.25 to 2.5 L/ha	 0.5 to 1 L/ac	▪ For control of fall-seeded rye and emerged weeds. ▪ Apply in the spring before spears emerge, but not closer than 7 days to harvest. ▪ **ONLY** 1 application per year may be used.
3rd Year & Established Asparagus — Before Spear Emergence or After Last Cutting (Soil Applied Grass Herbicide)			
trifluralin TREFLAN EC(480 g/L) RIVAL EC (500 g/L) BONANZA 400 (400 g/L)	1 to 2 kg/ha 2.08 to 4.16 L/ha 1.67 to 3.34 kg/ha 2.5 to 5 L/ha	 0.83 to 1.66 L/ac 0.67 to 1.33 kg/ac 1 to 2 L/ac	▪ PPI —Application should occur early enough in the spring to ensure that spears are not injured by the required incorporation (5–10 cm). ▪ Apply after last cutting of spears (postharvest disking) and incorporate. ▪ Use **ONLY** on established plantings of 3 years or older.
2nd Year & Established Asparagus — Before Spear Emergence or After Last Cutting (Postemergence Grass & Broadleaf Herbicides)			
paraquat GRAMOXONE (200 g/L)	0.6 to 1.1 kg/ha 3 to 5.5 L/ha	 1.2 to 2.2 L/ac	▪ Apply in 300–1100 L/ha (120–440 L/ac) water. Use the higher volume of water on dense weed growth. ▪ Apply to weed seedlings before asparagus tips appear or after the last cutting. ▪ **Do NOT** apply to emerged spears which are to be used for human consumption.
2nd Year & Established Asparagus — During Harvest Immediately After Cutting (Postemergence Broadleaf Herbicide)			
2,4-D * 2,4-D (470 g/L)	1.293 kg/ha 2.75 L/ha	 1.1 L/ac	▪ Apply in 50–200 L/ha (20–80 L/ac) water. ▪ May be applied early in the season just after a cutting. ▪ Spray immediately after a close harvest to avoid injury. ▪ Emerging spears may be twisted and should be discarded. Later emerging spears will be normal.
2nd Year & Established Asparagus — After Last Cutting (Postemergence Broadleaf Herbicides)			
2,4-D * 2,4-D (470 g/L)	0.94 to 1.293 kg/ha 2 to 2.75 L/ha	 0.8 to 1.1 L/ac	▪ Apply in 50–200 L/ha (20–80 L/ac) water. Apply 3 weeks after the post cutting disking. Direct spray to avoid wetting the asparagus fern.

Active ingredient TRADE NAME (Formulation)	RATE (active) PRODUCT PER HA	RATE PRODUCT PER ACRE	PRECAUTIONS (For more information see "Notes on Chemicals" section.)
2nd Year & Established Asparagus — After Last Cutting (Postemergence Grass Herbicides)			
fenoxaprop-p-ethyl EXCEL SUPER (80.5 g/L)	0.054 kg/ha 0.67 L/ha	 0.27 L/ac	▪ Apply to asparagus only after the spears have been harvested. ▪ **Do NOT** treat spears prior to or during harvest. ▪ Apply when majority of annual grasses are in the 1–6 leaf stage or until volunteer corn is up to 25 cm tall. ▪ Grasses emerging after application will not be controlled.
sethoxydim POAST ULTRA (450 g/L) plus surfactant/solvent MERGE	0.15 to 0.5 kg/ha 0.32 to 1.1 L/ha 1 to 2 L/ha	 0.13 to 0.45 L/ac 0.4 to 0.8 L/ac	▪ Apply to actively growing grasses. ▪ For annual grass, use 0.32 L/ha. Apply at the 1–6 leaf stage (2–5 is optimum). ▪ For volunteer grains, use 0.47 L/ha. Apply at the 1–6 leaf stage (2–5 is optimum). ▪ For quackgrass, use 1.1 L/ha. Apply up to the 3 leaf stage. Thorough preplant tillage will ensure more uniform quackgrass emergence. Cultivate after 7 days in wide row crops. Use the high rate of MERGE for quackgrass. ▪ Use 100–200 L water/ha (40–80 L water/ac). ▪ Grasses emerging after application will not be controlled. ▪ Spray tips angled forward 45° will give better coverage. ▪ **Do NOT** use flood jet or hollow cone nozzles. ▪ **Do NOT** apply if rain is expected within 1 hr. after application. ▪ Preharvest interval is 40 days.
2nd Year & Established Asparagus — After Last Cutting (Postemergence Grass & Broadleaf Herbicides)			
glufosinate ammonium IGNITE (150 g/L)	0.405 to 0.75 kg/ha 2.7 to 5 L/ha	 1.08 to 2 L/ac	▪ Apply in 110–330 L/ha (44–132 L/ac) water. ▪ Spray uniformly on emerged weeds prior to emergence of the fern. ▪ Weeds that have not emerged will not be controlled.

Beans (Lima and Snap) — see Chapter 7, Beans

Beets (Sugar) — see Sugar Beets

Beets (Red)

Site Preparation Before Planting — See Chapter 6, Special Methods of Weed Control

PREPLANT INCORPORATED (PPI) — Two incorporations at right angles operating at a depth of 10 cm using a double disk (7–10 km/hr) or vibrating shank S-tine cultivator (10–13 km/hr) are required unless otherwise stated. Cultivation-type equipment used for herbicide incorporation is known to spread perennial weeds to previously uninfested areas. Special attention should be directed toward machinery cleanliness, and/or treating fields with perennial weeds last.

PREEMERGENCE (PRE) — Rainfall at 15–20 mm within 7–10 days after application is necessary to activate preemergence treatments. Shallow cultivation, rotary hoeing or harrowing will control weed escapes and improves herbicide activity in the absence of rainfall.

Beets (Red) — Soil Applied Grass Herbicides			
cycloate RO-NEET (720 g/L)	3.42 to 4.5 kg/ha 4.75 to 6.25 L/ha	 1.9 to 2.5 L/ac	▪ PPI — Apply to a dry soil surface before planting and incorporated. ▪ Apply in 150–300 L/ha (60–120 L/ac) water. ▪ Use on mineral soils only. Not usually effective on highly organic soils. ▪ Use the lower rate on sandy soils.

Beets (Red) — Soil Applied Broadleaf Herbicides

pyrazon PYRAMIN FL (430 g/L)	3.54 to 4.4 kg/ha 8.25 to 10.25 L/ha	 3.3 to 4.1 L/ac	▪ PRE — Apply in 150–300 L/ha (60–120 L/ac) water. ▪ **Do NOT** use on soils less than 3% organic matter. ▪ Rainfall or irrigation is required to activate herbicide.
pebulate TILLAM (720 g/L)	4.5 to 8.82 kg/ha 6.25 to 12.25 L/ha	 2.5 to 4.9 L/ac	▪ PPI — Apply to a dry soil surface before planting and incorporated. ▪ Apply in 150–300 L water/ha. ▪ Use on mineral soils ONLY. Not usually effective on highly organic soils. ▪ Use lower rate on sandy soils.

Beets (Red) — Postemergence Broadleaf Herbicides

POSTEMERGENCE — Leaf stage of the weeds is critical for good weed control. Smaller weeds are generally easier to kill but there needs to be enough leaf surface to intercept the herbicide. Apply according to recommended leaf stages. Crop stage is important to optimize crop safety. Adjuvants will frequently improve the weed control when used as directed. Weather or other conditions may influence the optimum rate of adjuvant, see the product label for more details. Always use appropriate drift management technology.

pyrazon PYRAMIN FL (430 g/L) plus CITOWETT PLUS SUPER SPREADER STICKER	3.54 kg/ha 8.25 L/ha 2.5L/1000 L water	 3.3 L/ac 2.5L/1000 L water	▪ For best results, apply before third true beet leaf or broadleaf weeds. ▪ Apply in 300–400 L/ha (120–160 L/ac) water. ▪ **Do NOT** use any other oils or surfactants, including ASSIST or MERGE or crop injury may result.

Beets (Red) — Postemergence Grass and Broadleaf Herbicides

phenmedipham SPIN-AID (150 g/L)	0.75 to 1 kg/ha 5 to 6.6 L/ha	 2 to 2.64 L/ac	▪ Apply when weeds are past cotyledon up to the 4 true leaf stage, and red beets are past the 3 true leaf stage. Red beets in the cotyledon stage may be scorched. ▪ **Do NOT** apply more than twice per season. ▪ Use a maximum of 28 L of water/L SPIN-AID. ▪ May cause temporary growth retardation and/or chlorosis or tip burn on red beets. Beets usually resume normal growth within 10 days. ▪ **Do NOT** spray while dew is present. ▪ **Do NOT** spray if rainfall is expected within 6 hr., or weed kill may be reduced. ▪ Delay application until evening if days are hot (30°C or over) or rapid climatic change from cool, overcast days. **Do NOT** apply if beets are under stress.

Cabbage, Cauliflower, Broccoli, Brussels Sprouts

Site Preparation Before Planting — See Chapter 6, Special Methods of Weed Control

PREPLANT INCORPORATED (PPI) — Two incorporations at right angles operating at a depth of 10 cm using a double disk (7–10 km/hr) or vibrating shank S-tine cultivator (10–13 km/hr) are required unless otherwise stated. Cultivation-type equipment used for herbicide incorporation is known to spread perennial weeds to previously uninfested areas. Special attention should be directed toward machinery cleanliness, and/or treating fields with perennial weeds last.

PREEMERGENCE (PRE) — Rainfall at 15–20 mm within 7–10 days after application is necessary to activate preemergence treatments. Shallow cultivation, rotary hoeing or harrowing will control weed escapes and improve herbicide activity in the absence of rainfall.

Active ingredient TRADE NAME (Formulation	RATE (active) PRODUCT PER HA	RATE PRODUCT PER ACRE	PRECAUTIONS (For more information see "Notes on Chemicals" section
Cabbage, Cauliflower, Broccoli, Brussels Sprouts — Soil Applied Grass and Broadleaf Herbicides			
napropamide DEVRINOL DF (50 DF)	1.12 to 2.25 kg/ha 2.25 to 4.5 kg/ha	 0.9 to 1.8 kg/ac	▪ PPI or PRE — Use **ONLY** on transplanted cabbage, cauliflower, and broccoli. ▪ Use **ONLY** one application per year. ▪ Use the lower rate on light soils (coarse textured to sandy and sandy loam). ▪ Apply to well worked soil that is dry enough to permit thorough incorporation to a depth of 2.5–5.0 cm. ▪ Incorporate the same day as applied. ▪ Damage to subsequent cover crops can be reduced by tillage across the rows after harvest. Small grains seeded in the fall may be stunted but not otherwise affected. ▪ **Do NOT** harvest within 60 days.
s-metolachlor DUAL MAGNUM (915 g/L) or s-metolachlor/benoxacor DUAL II MAGNUM (915 g/L)	1.14 to 1.6 kg/ha 1.25 to 1.75 L/ha 1.14 to 1.6 kg/ha 1.25 to 1.75 L/ha	 0.5 to 0.7 L/ac 0.5 to 0.7 L/ac	▪ PRE to weeds — Apply after transplanting within 2 days, before weeds emerge. ▪ Use the higher rate for heavier weed pressure. ▪ Apply as a ground application only in 300 L water/ha. ▪ Use **ONLY** one application per year. ▪ **Do NOT** incorporate, and do not use on seeded cole crops. ▪ **Do NOT** apply to soil with less than 1% or more than 10% organic matter. ▪ Use **ONLY** on transplanted cabbage, cauliflower and broccoli.
trifluralin TREFLAN EC(480 g/L) RIVAL EC (500 g/L) BONANZA 400 (400 g/L)	0.6 to 1.1 kg/ha 1.25 to 2.3 L/ha 1.2 to 2.2 L/ha 1.5 to 2.75 L/ha	 0.5 to 0.92 L/ac 0.48 to 0.94 L/ac 0.6 to 1.1 L/ac	▪ PPI ▪ Use **ONLY** on direct seeded cabbage or cauliflower, or on transplants of cabbage, cauliflower, broccoli and Brussels sprouts.
Cabbage, Cauliflower, Broccoli, Brussels Sprouts — Postemergence Grass Herbicides			
POSTEMERGENCE — Leaf stage of the weeds is critical for good weed control. Smaller weeds are generally easier to kill but there needs to be enough leaf surface to intercept the herbicide. Apply according to recommended leaf stages. Crop stage is important to optimize crop safety. Adjuvants will frequently improve the weed control when used as directed. Weather or other conditions may influence the optimum rate of adjuvant, see the product label for more details. Always use appropriate drift management technology.			
fenoxaprop-p-ethyl EXCEL SUPER (80.5 g/L)	0.054 kg/ha 0.67 L/ha	 0.27 L/ac	▪ Apply when majority of annual grasses are in the 1–6 leaf stage or until volunteer corn is up to 25 cm tall. ▪ Grasses emerging after application will not be controlled. ▪ **Not registered** for use on Brussels sprouts.
fluazifop-p-butyl VENTURE L (125 g/L)	0.1 to 0.25 kg/ha 0.8 to 2 L/ha	 0.32 to 0.8 L/ac	▪ Apply to actively growing grasses prior to tillering. ▪ Apply at 0.8 L/ha (0.32 L/ac) at 2–5 leaf stage of annual grasses (2–4 leaf for foxtails), volunteer wheat and barley. ▪ Apply at 2 L/ha (0.8 L/ac) at 3–5 leaf stage of quackgrass & wirestem muhly. ▪ Thorough preplant tillage, fragmenting quackgrass rhizome improves control. ▪ Make one application per season. ▪ **Do NOT** cultivate between rows until 5 days after application.
sethoxydim POAST ULTRA (450 g/L) plus surfactant/solvent MERGE	0.15 to 0.5 kg/ha 0.32 to 1.1 L/ha 1 to 2 L/ha	 0.13 to 0.45 L/ac 0.4 to 0.8 L/ac	▪ Apply to actively growing grasses. ▪ For annual grass, use 0.32 L/ha. Apply at the 1–6 leaf stage. ▪ For volunteer grains, use 0.47 L/ha. ▪ For quackgrass, use 1.1 L/ha (**Do NOT** use this rate on broccoli). Apply up to the 3–

			leaf stage. Thorough preplant tillage will ensure more uniform quackgrass emergence. Cultivate after 7 days in wide row crops. Use the high rate of MERGE for quackgrass. ▪ Use 100–200 L water/ha (40–80 L water/ac). ▪ **Do NOT** apply closer than 70 days to harvest. ▪ **Do NOT** use on Brussels Sprouts. ▪ **Do NOT** exceed 0.45 L/ha on broccoli.
Cabbage, Cauliflower, Broccoli, Brussels Sprouts — Postemergence Broadleaf Herbicides			
clopyralid LONTREL 360 (360 g/L)	0.20 kg/ha 0.56 L/ha	 0.2 L/ac	▪ Apply **POST TRANSPLANT** as a ground application only, in 300 L water/ha. ▪ Use **ONLY** one application per year, no closer than 30 days to harvest. ▪ Use **ONLY** on transplanted cabbage, cauliflower and broccoli.
pyridate LENTAGRAN (45 WP)	0.9 kg/ha 2 kg/ha	 0.8 kg/ac	▪ May be applied following a PPI application of trifluralin. ▪ Use ONLY on direct-seeded or transplanted cabbage. ▪ Apply when crop is well established.

Carrots

Site Preparation Before Planting — See Chapter 6, Special Methods of Weed Control

PREPLANT INCORPORATED (PPI) — Two incorporations at right angles operating at a depth of 10 cm using a double disk (7–10 km/hr) or vibrating shank S-tine cultivator (10–13 km/hr) are required unless otherwise stated. Cultivation-type equipment used for herbicide incorporation is known to spread perennial weeds to previously uninfested areas. Special attention should be directed toward machinery cleanliness, and/or treating fields with perennial weeds last.

PREEMERGENCE (PRE) — Rainfall at 15–20 mm within 7–10 days after application is necessary to activate preemergence treatments. Shallow cultivation, rotary hoeing or harrowing will control weed escapes and improve herbicide activity in the absence of rainfall.

Carrots — Preplant Incorporated followed by Postemergence

trifluralin TREFLAN EC (480 g/L) RIVAL EC (500 g/L) BONANZA 400 (400 g/L) followed by linuron LOROX DF (50 DF) or linuron AFOLAN F (480 g/L) LINURON 480 (480 g/L)	0.6 to 1.1 kg/ha 1.25 to 2.4 L/ha 1.2 to 2.2 L/ha 1.5 to 2.75 L/ha 0.55 to 1.625 kg/ha 1.1 to 3.25 kg/ha 0.624 to 1.2 kg/ha 1.3 to 2.5 L/ha 1.1 to 2.25 L/ha	 0.5 to 0.96 L/ac 0.48 to 0.94 L/ac 0.6 to 1.1 L/ac 0.44 to 1.3 kg/ac 0.52 to 1 L/ac 0.44 to 0.9 L/ac	▪ PPI followed by POST. ▪ Use on mineral soils. ▪ Spray linuron when crop has 2 or more fully developed leaves (8–15 cm tall). ▪ Apply POST before annual grasses are 5 cm high & before broadleaf weeds are 15 cm high. ▪ Carrot leaves will become yellow or light green, but they soon recover. ▪ Use nozzle pressure of 175–275 kPa. **Do NOT** exceed 275 kPa. ▪ **Do NOT** apply linuron with herbicidal oil. ▪ **Do NOT** apply linuron during hot, dry weather (>32°C) or when crop is under stress. ▪ **Do NOT apply** linuron if heavy rains are expected. ▪ Use the lower rates on sandy soils and for smaller weeds. ▪ **Do NOT** use on coarse-textured soils low in organic matter.

Active ingredient TRADE NAME (Formulation)	RATE (active) PRODUCT PER HA	RATE PRODUCT PER ACRE	PRECAUTIONS (For more information see "Notes on Chemicals" section
Pre-emergence followed by Post-emergence			
linuron	0.55 to 1.125 kg/ha		• PRE followed by POST.
LOROX DF (50 DF)	1.1 to 2.25 kg/ha	0.44 to 0.9 kg/ac	• **Do NOT** apply the 2nd treatment closer than 2 weeks after the first treatment.
followed by linuron	1.125 to 2.25 kg/ha		• **Do NOT** apply more than 2 applications per season.
LOROX DF (50 DF)	2.25 to 4.5 kg/ha	0.9 to 1.8 kg/ac	• Spray POST when crop has 2 or more fully developed leaves (8–15 cm tall).
OR			• Apply POST before annual grasses are 5 cm high & before broadleaf weeds are 15 cm high.
linuron	0.624 to 0.912 kg/ha		
AFOLAN F (480 g/L)	1.3 to 1.9 L/ha	0.52 to 0.76 L/ac	• Carrot leaves will become yellow or light green, but they soon recover.
followed by linuron	0.912 to 1.2 kg/ha		• Use nozzle pressure of 175–275 kPa. **Do NOT** exceed 275 kPa.
AFOLAN F (480 g/L)	1.9 to 2.5 L/ha	0.76 to 1 L/ac	• **Do NOT** apply with herbicidal oil.
OR			• **Do NOT** apply during hot, dry weather (>32°C) or when crop is under stress.
linuron	0.53 to 1.08 kg/ha		• **Do NOT apply** if heavy rains are expected.
LINURON 480 (480 g/L)	1.1 to 2.25 L/ha	0.44 to 0.9 L/ac	• Use the lower rates on sandy soils and for smaller weeds.
followed by linuron	1.08 to 2.165 kg/ha		• **Do NOT** use on coarse-textured soils low in organic matter.
LINURON 480 (480 g/L)	2.25 to 4.5 L/ha	0.9 to 1.8 L/ac	
prometryne	1.8 to 3.4 kg/ha		• PRE followed by POST — Use on muck soils **ONLY**.
GESAGARD 480 SC (480 g/L)	3.75 to 7.08 L/ha	1.5 to 2.83 L/ac	• For POST – Spray when crop has 2 or more fully developed leaves (8–15 cm tall).
followed by linuron	0.55 to 1.625 kg/ha		• Apply before annual grasses are 5 cm high & broadleaf weeds are 15 cm high.
LOROX DF (50 DF)	1.1 to 3.25 kg/ha	0.44 to 1.3 kg/ac	• Carrot leaves will become yellow or light green, but they will soon regain their normal colour.
or linuron	0.624 to 1.2 kg/ha		
AFOLAN F (480 g/L)	1.3 to 2.5 L/ha	0.52 to 1 L/ac	• **Do NOT** apply during hot, dry weather (>32°C) or when crop is under stress.
			• **Do NOT apply** if heavy rains are expected.
			• Use the lower rates for smaller weeds.
Pre-emergence — Soil Applied Grass and Broadleaf Herbicides			
linuron	0.55 to 1.625 kg/ha		• PRE — Apply as a band or broadcast spray after planting but before carrots emerge.
LOROX DF (50 DF)	1.1 to 3.25 kg/ha	0.44 to 1.3 kg/ac	• Apply in 200–350 L/ha (80–140 L/ac) water.
or linuron	0.624 to 1.2 kg/ha		• Use the lower rate on sandy soils.
AFOLAN F (480 g/L)	1.3 to 2.5 L/ha	0.52 to 1 L/ac	• Carrots are very sensitive to this treatment at the time of emergence and severe injury can occur at this time if there is a heavy rain or if the area is irrigated.
prometryne	1.8 to 3.4 kg/ha		• PRE — apply soon after seeding.
GESAGARD 480 SC (480 g/L)	3.75 to 7.08 L/ha	1.5 to 2.83 L/ac	• Apply in 200–1000 L/ha (80–400 L/ac) water.
			• Use the lower rate on sandy soils and the higher rate on muck soils.
			• **Do NOT** use at or near time of emergence.
			• **Do NOT** use for POST use.
trifluralin	0.6 to 1.1 kg/ha		• PPI
TREFLAN EC (480 g/L)	1.25 to 2.4 L/ha	0.5 to 0.96 L/ac	
RIVAL EC (500 g/L)	1.2 to 2.2 L/ha	0.48 to 0.94 L/ac	
BONANZA 400 (400 g/L)	1.5 to 2.75 L/ha	0.6 to 1.1 L/ac	

Carrots — Postemergence Grass Herbicides

POSTEMERGENCE — Leaf stage of the weeds is critical for good weed control. Smaller weeds are generally easier to kill but there needs to be enough leaf surface to intercept the herbicide. Apply according to recommended leaf stages. Crop stage is important to optimize crop safety. Adjuvants will frequently improve the weed control when used as directed. Weather or other conditions may influence the optimum rate of adjuvant, see the product label for more details. Always use appropriate drift management technology.

diclofop-methyl HOE-GRASS 284 (284 g/L)	1 kg/ha 3.5 L/ha	 1.4 L/ac	▪ Apply to annual grasses in the 1–4 leaf stages (optimum control at 2–3 leaf stages), approximately 10–16 days after emergence. ▪ **Do NOT** apply if rain is expected within 1 hr. after application.
fenoxaprop-p-ethyl EXCEL SUPER (80.5 g/L)	0.054 kg/ha 0.67 L/ha	 0.27 L/ac	▪ Apply when majority of annual grasses are in the 1-6 leaf stage or until volunteer corn is up to 25 cm tall. ▪ Grasses emerging after application will not be controlled. ▪ **Do NOT** apply if rain is expected within 1 hr. after application.
fluazifop-p-butyl VENTURE L (125 g/L)	0.075 to 0.25 kg/ha 0.6 to 2 L/ha	 0.24 to 0.8 L/ac	▪ Apply when crop is 10 cm in height or less. ▪ Apply to actively growing grasses prior to tillering. ▪ Apply at 0.6 L/ha (0.24 L/ac) at 2–5 leaf stage of annual grasses (2–4 leaf for foxtails). ▪ Apply at 0.8 L/ha (0.32 L/ac) at 2–5 leaf stage of volunteer wheat and barley. ▪ Apply at 1–2 L/ha (0.4–0.8 L/ac) at 3–5 leaf stage of quackgrass & wirestem muhly. ▪ Thorough preplant tillage, fragmenting quackgrass rhizomes improves control ▪ **Do NOT** cultivate between rows until 5 days after application. ▪ Apply other postemergence herbicides separately at least 3 days after VENTURE L.
sethoxydim POAST ULTRA (450 g/L) plus surfactant/solvent MERGE	0.15 to 0.5 kg/ha 0.32 to 1.1 L/ha 1 to 2 L/ha	 0.13 to 0.45 L/ac 0.4 to 0.8 L/ac	▪ Apply to actively growing grasses. ▪ For annual grass, use 0.32 L/ha. Apply at the 1–6 leaf stage (2–5 is optimum). ▪ For volunteer grains, use 0.47 L/ha. Apply at the 1–6 leaf stage (2–5 is optimum). ▪ For quackgrass, use 1.1 L/ha. Apply up to the 3–leaf stage. Thorough preplant tillage will ensure more uniform quackgrass emergence. Cultivate after 7 days in wide row crops. Use the high rate of MERGE for quackgrass. ▪ Use 100–200 L water/ha (40–80 L water/ac). ▪ Grasses emerging after application will not be controlled. ▪ Spray tips angled forward 45° will give better coverage. ▪ **Do NOT** use flood jet or hollow cone nozzles. ▪ **Do NOT** apply if rain is expected within 1 hr. after application. ▪ Preharvest interval is 49 days.

Carrots — Postemergence Grass and Broadleaf Herbicides

linuron LOROX DF (50 DF) or linuron AFOLAN F (480 g/L)	1.125 to 2.25 kg/ha 2.25 to 4.5 kg/ha 0.912 to 2.256 kg/ha 1.9 to 4.69 L/ha	 0.9 to 1.8 kg/ac 0.76 to 1.88 L/ac	▪ For carrots not treated with linuron PRE. ▪ Spray when crop has 2 or more fully developed leaves (8–15 cm tall). ▪ Apply before annual grasses are 5 cm high & before broadleaf weeds are 15 cm high. ▪ Carrot leaves will become yellow or light green, but they will soon regain their normal colour. ▪ Use nozzle pressure of 175–275 kPa. **Do NOT** exceed 275 kPa. ▪ **Do NOT** apply with herbicidal oil. ▪ **Do NOT** apply during hot, dry weather (>32°C) or when crop is under stress.

Active Ingredient TRADE NAME Formulation	RATE Active PRODUCT PER HA	RATE PRODUCT PER ACRE	PRECAUTIONS For more information see "Notes on Chemical" section
mineral oil (herbicidal) overall spray rows only undiluted	 600 to 800 L/ha 300 to 400 L/ha	 240 to 320 L/ac 120 to 160 L/ac	▪ Apply as soon as true leaves develop and before carrot roots are thicker than a pencil. ▪ Later treatments may produce an oil flavor. ▪ Weeds should be less than 10 cm high. ▪ Ragweed, wormwood, and wild carrot are not controlled.

Celery

Site Preparation Before Planting — See Chapter 6, Special Methods of Weed Control

Celery — Postemergence Grass and Broadleaf Herbicides

POSTEMERGENCE — Leaf stage of the weeds is critical for good weed control. Smaller weeds are generally easier to kill but there needs to be enough leaf surface to intercept the herbicide. Apply according to recommended leaf stages. Crop stage is important to optimize crop safety. Adjuvants will frequently improve the weed control when used as directed. Weather or other conditions may influence the optimum rate of adjuvant, see the product label for more details. Always use appropriate drift management technology.

linuron AFOLAN F (480 g/L)	0.9 to 2.25 kg/ha 1.87 to 4.68 L/ha	 0.75 to 1.87 L/ac	▪ Apply 8 to 10 days after transplanting. ▪ Apply in 150–300 L/ha (60–120 L/ac) water in the transplanted crop. ▪ Some yellowing of the leaves may be noticed but this will be temporary.
mineral oil (herbicidal) overall spray rows only undiluted	 600 to 800 L/ha 300 to 400 L/ha	 240 to 320 L/ac 120 to 160 L/ac	▪ Apply as the true leaves develop on the celery, before weeds are 10 cm high. ▪ Use **ONLY** on outdoor seedbed and **ONLY** if the soil is moist.
prometryne GESAGARD 480 SC (480 g/L)	1.8 to 2.2 kg/ha 3.75 to 4.58 L/ha	 1.5 to 1.83 L/ac	▪ **Do NOT** apply until 21 days after transplanting crop when the celery plants are established. ▪ Apply in 200–1000 L/ha (80–400 L/ac) water in the transplanted crop. ▪ **Do NOT** use on direct seeded crop.

Corn (Sweet) — See Chapter 9, Corn, Field & Sweet

Cucumber

Site Preparation Before Planting — See Chapter 6, Special Methods of Weed Control

PREEMERGENCE (PRE) — Rainfall at 15–20 mm within 7–10 days after application is necessary to activate preemergence treatments. Shallow cultivation, rotary hoeing or harrowing will control weed escapes and improves herbicide activity in the absence of rainfall.

Cucumber — Preplant (Stale Seedbed Technique)

glyphosate* glyphosate (360 g/L)	0.267 to 1.246 kg/ha 0.75 to 3.5 L/ha	 0.3 to 1.4 L/ac	▪ Till and fertilize soil in early spring, and then allow weeds to grow. ▪ Spray weeds just before seeding crop. ▪ Use low rate for small weeds (8 cm), medium rates for weeds 8–15 cm and higher rate for weeds over 15 cm tall. ▪ Apply recommended PRE or POST herbicides to control new flushes of weeds or use mechanical means of control.

Cucumber — Soil Applied Grass Herbicides

bensulide PREFAR (480 g/L)	5.75 to 6.75 kg/ha 12 to 14 L/ha	 4.8 to 5.6 L/ac	▪ PPI — for mineral soils **ONLY**. ▪ Incorporate thoroughly into the soil to a depth of 2.5–5 cm.

Cucumber — Soil Applied Broadleaf Herbicides

naptalam	2.64 to 7.19 kg/ha		• PRE — Apply after seeding cucumbers, but before weeds emerge.
ALANAP (240 g/L)	11 to 30 L/ha	4.4 to 12 L/ac	• May also be applied as a POST spray about one month after the preemergence spray when the crop has emerged following a clean cultivation

Cucumber — Soil Applied Grass and Broadleaf Herbicides

bensulide	4.56 to 6.75 kg/ha		• PPI (incorporate PREFAR to a depth of 2.5–5 cm), followed by ALANAP PRE.
PREFAR (480 g/L)	9.5 to 14 L/ha	3.8 to 5.6 L/ac	• May also be tank-mixed PPI (**Do NOT** incorporate deeper than 2.5 cm).
followed by naptalam	2.28 to 4.56 kg/ha		• **Do NOT** use on muck soils.
ALANAP (240 g/L)	9.5 to 19 L/ha	3.8 to 7.7 L/ac	• Use the lower rates on light, sandy soils.

Cucumber — Postemergence Grass Herbicides

POSTEMERGENCE — Leaf stage of the weeds is critical for good weed control. Smaller weeds are generally easier to kill but there needs to be enough leaf surface to intercept the herbicide. Apply according to recommended leaf stages. Crop stage is important to optimize crop safety. Adjuvants will frequently improve the weed control when used as directed. Weather or other conditions may influence the optimum rate of adjuvant, see the product label for more details. Always use appropriate drift management technology.

fluazifop-p-butyl	0.1 to 0.25 kg/ha		• Apply to actively growing grasses prior to tillering.
VENTURE L (125 g/L)	0.8 to 2 L/ha	0.32 to 0.8 L/ac	• Apply at 0.8 L/ha (0.32 L/ac) at 2–5 leaf stage of annual grasses (2–4 leaf for foxtails, volunteer wheat and barley. • Apply at 1 to 2 L/ha (0.4 to 0.8 L/ac) at 3–5 leaf stage of quackgrass & wirestem muhly. • Thorough preplant tillage, fragmenting quackgrass rhizome improves control. • **Do NOT** cultivate between rows until 5 days after application. • Make one application per season.
sethoxydim	0.15 to 0.5 kg/ha		• Apply to actively growing grasses.
POAST ULTRA (450 g/L)	0.32 to 1.1 L/ha	0.13 to 0.45 L/ac	• For annual grass, use 0.32 L/ha. Apply at the 1–6 leaf stage.
plus surfactant/solvent			• For volunteer grains, use 0.47 L/ha.
MERGE	1 to 2 L/ha	0.4 to 0.8 L/ac	• For quackgrass, use 1.1 L/ha. Apply up to the 3–leaf stage. Thorough preplant tillage will ensure more uniform quackgrass emergence. Cultivate after 7 days in wide row crops. Use the high rate of MERGE for quackgrass. • Use 100–200 L water/ha (40–80 L water/ac). • **Do NOT** apply closer than 30 days to harvest.

Garlic

Site Preparation Before Planting – See Chapter 6, Special Methods of Weed Control

PREEMERGENCE (PRE) — Rainfall at 15–20 mm within 7–10 days after application is necessary to activate preemergence treatments. Shallow cultivation, rotary hoeing or harrowing will control weed escapes and improve herbicide activity in the absence of rainfall.

Garlic — Soil Applied Grass and Broadleaf Herbicides

napropamide	1.12 to 2.25 kg/ha		• PRE — One application per year only, prior to crop and weed emergence.
DEVRINOL DF (50 DF)	2.25 to 4.5 kg/ha	0.9 to 1.8 kg/ac	• Use the lower rate on light soils (coarse textured to sandy and sandy loam). • **Do NOT** apply closer than 60 days to harvest. • Damage to subsequent crops and cover crops can be reduced by tillage across the rows after harvest. Small grains seeded in the fall may be stunted but not otherwise affected.

TRADE NAME (Formulation)	RATE (active) PRODUCT PER HA	RATE PRODUCT PER ACRE	PRECAUTIONS (For more information see Notes on Chemicals section.)
Garlic — Postemergence Grass Herbicides			
POSTEMERGENCE — Leaf stage of the weeds is critical for good weed control. Smaller weeds are generally easier to kill but there needs to be enough leaf surface to intercept the herbicide. Apply according to recommended leaf stages. Crop stage is important to optimize crop safety. Adjuvants will frequently improve the weed control when used as directed. Weather or other conditions may influence the optimum rate of adjuvant, see the product label for more details. Always use appropriate drift management technology.			
sethoxydim POAST ULTRA (450 g/L) plus surfactant/solvent	0.15 to 0.5 kg/ha 0.32 to 1.1 L/ha	 0.13 to 0.45 L/ac	• Apply to actively growing grasses. • For annual grass, use 0.32 L/ha. Apply at the 1–6 leaf stage. • For volunteer grains, use 0.47 L/ha.
MERGE	1 to 2 L/ha	0.4 to 0.8 L/ac	• For quackgrass, use 1.1 L/ha. Apply up to the 3–leaf stage. Thorough preplant tillage will ensure more uniform quackgrass emergence. Cultivate after 7 days in wide row crops. Use the high rate of MERGE for quackgrass. • Use 100–200 L water/ha (40–80 L water/ac). • **Do NOT** apply closer than 50 days to harvest.
Garlic — Postemergence Broadleaf Herbicides			
bromoxynil PARDNER (280 g/L)	0.28 kg/ha 1 L/ha	 0.4 L/ac	• Apply to actively growing broadleaf weeds at the 1–4 leaf stage. • Apply in 200–300 L water/ha (80–100 L water/ac). • Apply at 275 kPa. • Use one ground application per year **ONLY**. • **Do NOT** use flood jet nozzles. • **Do NOT** spray at temperatures above 25°C. • **Do NOT** apply closer than 58 days to harvest.
Ginseng			
Site Preparation Before Planting — See Chapter 6, Special Methods of Weed Control			
POSTEMERGENCE — Leaf stage of the weeds is critical for good weed control. Smaller weeds are generally easier to kill but there needs to be enough leaf surface to intercept the herbicide. Apply according to recommended leaf stages. Crop stage is important to optimize crop safety. Adjuvants will frequently improve the weed control when used as directed. Weather or other conditions may influence the optimum rate of adjuvant, see the product label for more details. Always use appropriate drift management technology.			
Ginseng — Postemergence Grass Herbicide			
fluazifop-p-butyl VENTURE L (125 g/L)	0.8 to 2 L/ha	0.32 to 0.8 L/ac	• Apply POST up to 3 times/year: early May, late June and/or mid-August. • Apply to actively growing grasses prior to tillering. • DO NOT apply in the year of harvest.
Ginseng — Postemergence Grass & Broadleaf Herbicide			
glyphosate TMS TOUCHDOWN 480 (360 g/L)	0.9 kg/ha 2.5 L/ha	 1.0 L/ac	• Apply POST once in the spring before the crop has emerged above the soil. • Apply in 50–100 L water/ha. • DO NOT exceed rate or spray volume as crop injury may result. • DO NOT contact actively growing ginseng foliage. • DO NOT use a fall application in existing/established gardens.

Herbs

Site Preparation Before Planting — See Chapter 6, Special Methods of Weed Control

PREPLANT INCORPORATED (PPI) — Two incorporations at right angles operating at a depth of 10 cm using a double disk (7–10 km/hr) or vibrating shank S-tine cultivator (10–13 km/hr) are required unless otherwise stated. Cultivation-type equipment used for herbicide incorporation is known to spread perennial weeds to previously uninfested areas. Special attention should be directed toward machinery cleanliness, and/or treating fields with perennial weeds last.

PREEMERGENCE (PRE) — Rainfall at 15–20 mm within 7–10 days after application is necessary to activate preemergence treatments. Shallow cultivation, rotary hoeing or harrowing will control weed escapes

Herbs — Soil Applied Grass and Broadleaf Herbicides

napropamide DEVRINOL DF (50 DF)	0.56 to 1.12 kg/ha 1.12 to 2.24 kg/ha	 0.45 to 0.9 kg/ac	• PRE or PPI — Use on basil **ONLY**. • Apply in 200–900 L/ha (80–360 L/ac) water. • One application per year. • **Do NOT** plant non-labeled crops until 12 months after application to avoid injury. • High rates may result in temporary crop stunting or retardation. However, crops will outgrow the injury and yield is unaffected.
terbacil SINBAR (80 WP)	1.4 kg/ha 1.75 kg/ha	 0.7 kg/ac	• PRE — Use on peppermint and spearmint **ONLY.** • Apply once per crop season the end of September to early October. • **Do NOT** apply closer than 9 or 10 months to harvest. • **Do NOT** use on soils with less than 1% OM.

Herbs — Postemergence Grass Herbicides

POSTEMERGENCE — Leaf stage of the weeds is critical for good weed control. Smaller weeds are generally easier to kill but there needs to be enough leaf surface to intercept the herbicide. Apply according to recommended leaf stages. Crop stage is important to optimize crop safety. Adjuvants will frequently improve the weed control when used as directed. Weather or other conditions may influence the optimum rate of adjuvant, see the product label for more details. Always use appropriate drift management technology.

sethoxydim POAST ULTRA (450 g/L) plus surfactant/solvent MERGE	0.15 to 0.2 kg/ha 0.32 to 0.65 L/ha 1 to 2 L/ha	 0.13 to 0.19 L/ac 0.4 to 0.8 L/ac	• Use on spearmint and peppermint **ONLY.** • Apply to actively growing grasses. • For annual grass, use 0.32 L/ha. Apply at the 1–6 leaf stage. • For volunteer grains, use 0.47 L/ha. • For quackgrass suppression, use 0.65 L/ha. Apply up to the 3–leaf stage. Thorough preplant tillage will ensure more uniform quackgrass emergence. Cultivate after 7 days in wide row crops. Use the high rate of MERGE for quackgrass. • Apply using 110–200 L/ha (44 –80 L/ac) water. • **Do NOT** apply closer than 30 days to harvest.

Leeks

Site Preparation Before Planting — See Chapter 6, Special Methods of Weed Control

POSTEMERGENCE — Leaf stage of the weeds is critical for good weed control. Smaller weeds are generally easier to kill but there needs to be enough leaf surface to intercept the herbicide. Apply according to recommended leaf stages. Crop stage is important to optimize crop safety. Adjuvants will frequently improve the weed control when used as directed. Weather or other conditions may influence the optimum rate of adjuvant, see the product label for more details. Always use appropriate drift management technology.

Active ingredient TRADE NAME Formulation	RATE (active) PRODUCT PER HA	RATE PRODUCT PER ACRE	PRECAUTIONS For more information see "Notes on Chemicals" section
Leeks — Postemergence Grass and Broadleaf Herbicides			
Prometryne GESAGARD 480 SC (480 g/L)	1.8 kg/ha 3.75 L/ha	 1.5 L/ac	▪ Apply 2 applications 10 days apart, before weeds are 5 cm high. ▪ Make the first application to well-established transplanted leeks that have produced one new fully expanded leaf. ▪ Can be used on either muck or mineral soils. ▪ **Do NOT** use more than 2 applications a year. ▪ Temporary injury can occur to the lower leaves in some cultivars of leek.
Lettuce			
Site Preparation Before Planting — See Chapter 6, Special Methods of Weed Control			
PREEMERGENCE (PRE) — Rainfall at 15–20 mm within 7 –10 days after application is necessary to activate preemergence treatments. Shallow cultivation, rotary hoeing or harrowing will control weed escapes and improve herbicide activity in the absence of rainfall.			
Lettuce — Soil Applied Grass and Broadleaf Herbicides			
chlorpropham CIPC EC (480 g/L)	4.5 to 6.75 kg/ha 9.36 to 14 L/ha	 3.74 to 5.6 L/ac	▪ PRE. ▪ When overhead irrigation is used at seeding time, delay application until after first irrigation but before crop emergence. ▪ Use lower rates in cool, wet weather to avoid injury and delay in emergence. ▪ Use lower rates in mineral soils.
propyzamide KERB (50 WP)	2.2 to 4.5 kg/ha 4.4 to 9 kg/ha	 1.76 to 3.6 kg/ac	▪ For direct seeded lettuce. apply PPI, PRE, or POST after the crop emerges to weed free soil. ▪ For transplanted lettuce, apply 7–10 days after transplanting to weed free soil. ▪ Use only once per year. ▪ **Do NOT** replant lettuce in KERB-treated fields in the same year. ▪ **Do NOT** use on muck soils. ▪ **Do NOT** apply closer than 55 days to harvest.
Muskmelon, Watermelon, Squash and Pumpkin			
Site Preparation Before Planting — See Chapter 6, Special Methods of Weed Control			
PREEMERGENCE (PRE) — Rainfall at 15–20 mm within 7 –10 days after application is necessary to activate preemergence treatments. Shallow cultivation, rotary hoeing or harrowing will control weed escapes and improve herbicide activity in the absence of rainfall.			
Muskmelon, Watermelon, Squash and Pumpkin — Soil Applied Broadleaf Herbicides			
naptalam ALANAP (240 g/L)	2.638 to 7.194 kg/ha 11 to 30 L/ha	 4.4 to 12 L/ac	▪ **PRE** prior to crop and weed emergence. ▪ **Do NOT** use on butternut squash; some injury may occur to Table Queen squash. ▪ May be applied to melons (not squash or pumpkins) as a POST about 1 month after the preemergence spray when the crop has emerged but before the weeds are up.

Muskmelon, Watermelon, Squash and Pumpkin — Soil Applied Grass and Broadleaf Herbicides

napropamide	1.12 to 2.25 kg/ha		• PRE — one application per season.
DEVRINOL DF (50 DF)	2.24 to 4.5 kg/ha	0.9 to 1.8 kg/ac	• Use on direct seeded pumpkin and squash **ONLY**.
			• Apply in 200–900 L/ha (80–360 L/ac) water.
			• Use the lower rate on light soils (coarse textured, sandy or sandy loam).
			• Shepherd's purse and lady's-thumb may escape treatment at this rate.
			• Apply before rainfall if irrigation is not available.
			• Damage to subsequent crops and cover crops can be reduced by tillage across the rows after harvest. Small grains seeded in the fall may be stunted but not otherwise affected.

Muskmelon, Watermelon, Squash and Pumpkin — Postemergence Grass Herbicides

POSTEMERGENCE — Leaf stage of the weeds is critical for good weed control. Smaller weeds are generally easier to kill but there needs to be enough leaf surface to intercept the herbicide. Apply according to recommended leaf stages. Crop stage is important to optimize crop safety. Adjuvants will frequently improve the weed control when used as directed. Weather or other conditions may influence the optimum rate of adjuvant, see the product label for more details. Always use appropriate drift management technology.

sethoxydim	0.15 to 0.2 kg/ha		• For pumpkins and squash **ONLY**.
POAST ULTRA (450 g/L)	0.32 to 1.1 L/ha	0.13 to 0.45 L/ac	• Apply to actively growing grasses.
plus surfactant/solvent			• For annual grass, use 0.32 L/ha. Apply at the 1–6 leaf stage.
MERGE	1 to 2 L/ha	0.4 to 0.8 L/ac	• For volunteer grains, use 0.47 L/ha.
			• For quackgrass, use 1.1 L/ha. Apply up to the 3–leaf stage. Thorough preplant tillage will ensure more uniform quackgrass emergence. Cultivate after 7 days in wide row crops. Use the high rate of MERGE for quackgrass.
			• Use 100–200 L water/ha (40–80 L water/ac).
			• **Do NOT** apply closer than 30 days to harvest.

Onions

Site Preparation Before Planting — See Chapter 6, Special Methods of Weed Control

Most experience with herbicides below has been with the seeded crop. Experience with sets and limited experience with Spanish onions have been satisfactory. On green bunching onions, the granular formulations (applied when the leaves are dry) are recommended to avoid leaf injury.

PREEMERGENCE (PRE) — Rainfall at 15–20 mm within 7–10 days after application is necessary to activate preemergence treatments. Shallow cultivation, rotary hoeing or harrowing will control weed escapes

Onions — Soil Applied Grass and Broadleaf Herbicides

chlorpropham	4.5 to 9 kg/ha		• PRE or DIRECTED POST — when weed seeds are germinating.
CIPC EC (480 g/L)	9.36 to 18.72 L/ha	3.74 to 7.49 L/ac	• Apply these rates on muck soils. Use 9.36 to 14 L/ha (3.74 to 5.6 L/ac) on mineral soils.
CIPC GR (20 Gr)	22.5 to 45 kg/ha	9 to 18 kg/ac	• Cool, moist conditions may result in reduced stand and yields.
			• Avoid onion leaves with directed spray.
			• Excellent control of purslane may be obtained.
			• Groundsel, lamb's-quarters and ragweed are somewhat resistant.
			• **Do NOT** use on bunching onions.

Active ingredient TRADE NAME Formulation	RATE active PRODUCT PER HA	RATE PRODUCT PER ACRE	PRECAUTIONS For more information see "Notes on Chemicals" section
Onions — Postemergence Grass Herbicides			
POSTEMERGENCE — Leaf stage of the weeds is critical for good weed control. Smaller weeds are generally easier to kill but there needs to be enough leaf surface to intercept the herbicide. Apply according to recommended leaf stages. Crop stage is important to optimize crop safety. Adjuvants will frequently improve the weed control when used as directed. Weather or other conditions may influence the optimum rate of adjuvant, see the product label for more details. Always use appropriate drift management technology.			
clethodim SELECT (240 g/L)	0.09 kg/ha 0.38 L/ha	 0.15 L/ac	• For control of annual blue grass, other annual grasses and quackgrass. • Apply when the crop is in the 1–4 leaf stage and the weeds are in the 2–6 leaf stage.
diclofop-methyl HOE-GRASS 284 (284 g/L)	1 kg/ha 3.5 L/ha	 1.4 L/ac	• Apply to annual grasses in the 1–4 leaf stage (optimum 2–3 leaf stage). • Apply 10–16 days after emergence. • **Do NOT** apply if rain is expected within 1 hr. after application.
fenoxaprop-p-ethyl EXCEL SUPER (80.5 g/L)	0.054 kg/ha 0.67 L/ha	 0.27 L/ac	• Apply to annual grasses in the 1–6 leaf stage, or until volunteer corn is 25 cm tall. • Annual grasses will not be controlled if emergence occurs after application. • **Do NOT** apply if rain is expected within 1 hr. after application.
fluazifop-p-butyl VENTURE L (125 g/L)	0.075 to 0.25 kg/ha 0.6 to 2 L/ha	 0.24 to 0.8 L/ac	• Apply to actively growing grasses before tillering. • Apply at 0.6 L/ha (0.24 L/ac) at 2–5 leaf stage of annual grasses. • Apply at 0.8 L/ha (0.32 L/ac) at 2–5 leaf stage of volunteer wheat and barley. • Apply at 1 to 2 L/ha (0.4 to 0.8 L/ac) at 3–5 leaf stage of quackgrass & wirestem muhly. • Apply in a maximum volume of 300 L/ha (120 L/ac). • Thorough preplant tillage, fragmenting quackgrass rhizomes improves control. • **Do NOT** cultivate between rows until 5 days after application. • **Do NOT** apply closer than 42 days before harvest.
sethoxydim POAST ULTRA (450 g/L) plus surfactant/solvent MERGE	0.15 to 0.5 kg/ha 0.32 to 1.1 L/ha 1 to 2 L/ha	 0.13 to 0.45 L/ac 0.4 to 0.8 L/ac	• For dry bulb onions **ONLY**. • Apply to actively growing grasses. • For annual grass, use 0.32 L/ha. Apply at the 1–6 leaf stage. • For volunteer grains, use 0.47 L/ha. • For quackgrass, use 1.1 L/ha. Apply up to the 3–leaf stage. Thorough preplant tillage will ensure more uniform quackgrass emergence. Cultivate after 7 days in wide row crops. Use the high rate of MERGE for quackgrass. • Use 100–200 L water/ha (40–80 L water/ac). • **Do NOT** apply closer than 50 days to harvest.
Onions — Postemergence Broadleaf Herbicides			
oxyfluorfen GOAL 2XL (240 g/L)	0.12 kg/ha 0.5 L/ha	 0.2 L/ac	• Apply after onions have 2 fully developed leaves. • Apply in minimum of 500 L/ha (200 L/ac) water. • **Do NOT** exceed a total of 2.0 L/ha (0.8 L/ac) per year. • **Permits** are required from the Ontario Ministry of the Environment under the *Pesticides Act* for this use. Permit applications should be made to the Ministry of Environment Pesticide Control Field Officers. See Appendix for the closest office.

Onions — Postemergence Grass and Broadleaf Herbicides

pendimethalin PROWL 400 (400 g/L)	1 to 1.5 kg/ha 2.5 to 3.75 L/ha	1 to 1.5 L/ac	• For mineral soils, use on direct seeded dry bulb onions . • Apply at the 2–leaf stage and 6–leaf stage of crop development for season long control. • Destroy existing weeds prior to application.
pendimethalin PROWL 400 (400 g/L)	3 kg/ha 7.5 L/ha	3 L/ac	• For muck soils, use on direct seeded dry bulb onions. • Apply at the loop and/or 2–leaf stage of crop development for season long control. • Destroy existing weeds prior to application.

Parsnips

Site Preparation Before Planting — See Chapter 6, Special Methods of Weed Control

PREEMERGENCE (PRE) — Rainfall at 15–20 mm within 7–10 days after application is necessary to activate preemergence treatments. Shallow cultivation, rotary hoeing or harrowing will control weed escapes and improve herbicide activity in the absence of rainfall.

Parsnips — Soil Applied Grass and Broadleaf Herbicides

chlorpropham CIPC EC (480 g/L) CIPC (20 Gr)	4.5 to 9 kg/ha 9.36 to 18.72 L/ha 22.5 to 45 kg/ha	 3.75 to 7.5 L/ac 9 to 18 kg/ac	• PRE – Apply at time of seeding or until shortly before emergence of crop and weeds. • Use the lower rate on mineral soils and the higher rate on muck. .
linuron AFOLAN F (480 g/L)	0.624 to 1.2 kg/ha 1.3 to 2.5 L/ha	 0.5 to 1 L/ac	• PRE – Apply soon after seeding. • Apply in 200 to 400 L/ha (80 to 160 L/ac) water. • Use lower rate on sandy soil. • Heavy rains or irrigation at time of emergence may cause injury.
linuron AFOLAN F (480 g/L) followed by linuron AFOLAN F (480 g/L)	0.624 to 0.912 kg/ha 1.3 to 1.9 L/ha 0.912 to 1.2 kg/ha 1.9. to 2.5 L/ha	 0.5 to 0.75 L/ac 0.75 to 1 L/ac	• PRE, followed by POST. • These treatments must be at least 2 weeks apart. • **Do NOT** apply more than these 2 applications per season.

Parsnips — Postemergence Grass and Broadleaf Herbicides

POSTEMERGENCE — Leaf stage of the weeds is critical for good weed control. Smaller weeds are generally easier to kill but there needs to be enough leaf surface to intercept the herbicide. Apply according to recommended leaf stages. Crop stage is important to optimize crop safety. Adjuvants will frequently improve the weed control when used as directed. Weather or other conditions may influence the optimum rate of adjuvant, see the product label for more details. Always use appropriate drift management technology.

linuron AFOLAN F (480 g/L)	0.912 to 2.256 kg/ha 1.9 to 4.7 L/ha	 0.76 to 1.88 L/ac	• Apply after parsnips are 8 cm tall. • **Do NOT** use more than 2.5 L/ha (1 L/ac) on sandy soils. • Avoid high temperatures, especially at the higher rate.
mineral oil (herbicidal) overall spray rows only undiluted	 600 to 800 L/ha 300 to 400 L/ha	 240 to 320 L/ac 120 to 160 L/ac	• Apply as soon as true leaves develop and before parsnips roots are pencil thickness. • Later treatments may produce an oil flavor. • Weeds should be less than 10 cm high.

Active ingredient TRADE NAME (Formulation)	RATE (active) PRODUCT PER HA	RATE PRODUCT PER ACRE	PRECAUTIONS (For more information see "Notes on Chemicals" section)

Peas

Site Preparation Before Planting — See Chapter 8, Special Methods of Weed Control

PREPLANT INCORPORATED (PPI) — Two incorporations at right angles operating at a depth of 10 cm using a double disk (7–10 km/hr) or vibrating shank S-tine cultivator (10–13 km/hr) are required unless otherwise stated. Cultivation-type equipment used for herbicide incorporation is known to spread perennial weeds to previously uninfested areas. Special attention should be directed toward machinery cleanliness, and/or treating fields with perennial weeds last.

PREEMERGENCE (PRE) — Rainfall of 15–20 mm within 7–10 days after application is necessary to activate preemergence treatments. Shallow cultivation, rotary hoeing or harrowing will control weed escapes and improve herbicide activity in the absence of rainfall.

Peas — Soil Applied Grass Herbicides

s-metolachlor DUAL MAGNUM (915 g/L)	1.14 to 1.6 kg/ha 1.25 to 1.75 L/ha	 0.5 to 0.7 L/ac	▪ Apply PRE. ▪ **Do NOT** use on muck, peat, high organic matter soils or soils with less than 1% organic matter. ▪ Use the higher rate for heavier weed populations. ▪ Apply by ground application equipment only.
triallate AVADEX BW (400 g/L)	1.7 kg/ha 4.25 L/ha	 1.7 L/ac	▪ Apply PPI. Incorporate within 24 hr. of application. ▪ Use **ONLY** on dry peas.
trifluralin TREFLAN EC(480 g/L) RIVAL EC (500 g/L) BONANZA 400 (400 g/L)	0.6 to 0.8 kg/ha 1.25 to 1.66 L/ha 1 to 1.3 kg/ha 1.5 to 2 L/ha	 0.5 to 0.66 L/ac 0.4 to 0.52 kg/ac 0.6 to 0.8 L/ac	▪ Apply PPI. Incorporate within 24 hr. of application. ▪ **Do NOT** exceed the low rate on medium textured soils. ▪ **Do NOT** apply to peat or muck soils (> 15% organic matter). ▪ **Do NOT** apply to soils with < 2% organic matter. ▪ **Do NOT** apply to fields spread with manure within the last 12 months. ▪ **Do NOT** apply by air.

Peas — Soil Applied Broadleaf Herbicides

prometryne GESAGARD 480 (480 g/L)	1.8 to 2.2 kg/ha 3.75 to 4.58 L/ha	 1.5 to 1.83 L/ac	▪ Apply PRE — Apply before weeds emerge, including Eastern black nightshade. ▪ Apply in 200–1000 L/ha (80–400 L/ac) water. ▪ Apply only once per year. ▪ Use lower rate on sandy soils. ▪ Preharvest interval is 55 days.

Peas — Soil Applied Grass and Broadleaf Herbicides

imazethapyr PURSUIT (240 g/L)	0.075 kg/ha 0.312 L/ha	 0.125 L/ac	▪ Apply PPI or PRE. ▪ Apply only once per year. ▪ Allow at least 24 months between PPI applications. ▪ Preharvest interval is 60 days.

Peas — Postemergence Grass Herbicides

POSTEMERGENCE — Leaf stage of the weeds is critical for good weed control. Smaller weeds are generally easier to kill but there needs to be enough leaf surface to intercept the herbicide. Apply according to recommended leaf stages. Crop stage is important to optimize crop safety. Adjuvants will frequently improve the weed control when used as directed. Weather or other conditions may influence the optimum rate of adjuvant, see the product label for more details. Always use appropriate drift management technology.

diclofop-methyl HOE-GRASS 284 (284 g/L)	0.7 to 0.8 kg/ha 2.5 to 2.8 L/ha	 1 to 1.1 L/ac	• Apply POST when annual grasses are in the 1–4 leaf stage (2–3 is optimum) and volunteer corn is 15–25 cm in height. • Use the high rate if wild oats are in the 4–5 leaf stage. • **Do NOT** graze field in the treated year. • **Do NOT** apply other herbicides within 4 days of HOE-GRASS application. • Apply HOE-GRASS before the use of any POST broadleaf herbicide other than BASAGRAN. • **Do NOT** apply if rain is expected within 1 hr. after application. • Preharvest interval is 60 days.
fenoxaprop-p-ethyl EXCEL SUPER (80.5 g/L)	0.054 kg/ha 0.67 L/ha	 0.27 L/ac	• Apply POST when annual grasses are in the 1–6 leaf stage and volunteer corn is up to 25 cm tall. • **Do NOT** graze treated field prior to harvest. • Annual grasses emerging after application will not be controlled. • **Do NOT** apply herbicides other than BASAGRAN within 4 days of application. • **Do NOT** apply by air. • **Do NOT** use flood jet nozzles or controlled droplet application equipment. • Spray tips angled forward 45° will give better coverage. • **Do NOT** apply if rain is expected within 1 hr. after application. • Preharvest interval is 75 days.
sethoxydim POAST ULTRA (450 g/L) surfactant/solvent MERGE	0.15 to 0.5 kg/ha 0.32 to 1.1 L/ha 1 to 2 L/ha	 0.13 to 0.45 L/ac 0.4 to 0.8 L/ac	• Apply POST to actively growing grasses. • For annual grass, use 0.32 L/ha. Apply at the 1–6 leaf stage (2–5 is optimum). • For volunteer grains, use 0.47 L/ha. Apply at the 1–6 leaf stage (2–5 is optimum). • For quackgrass, use 1.1 L/ha. Apply up to the 3–leaf stage. Thorough preplant tillage will ensure more uniform quackgrass emergence. Cultivate after 7 days in wide row crops. Use the high rate of MERGE for quackgrass. • Use 100–200 L water/ha (40–80 L water/ac). • Grasses emerging after application will not be controlled. • **Do NOT** apply herbicides other than MCPA SODIUM 300 or PURSUIT within 4 days of application. • **Do NOT** graze treated crop. • Spray tips angled forward 45° will give better coverage. • **Do NOT** use flood jet or hollow cone nozzles. • **Do NOT** apply if rain is expected within 1 hr. after application. • Use **ONLY** on fresh or dry processing peas, **NOT** fresh edible pod peas. • Preharvest interval is 30 days for fresh processing peas. • Preharvest interval is 60 days for dry peas.

Active Ingredient TRADE NAME, Formulation	RATE (active)/ PRODUCT PER HA	RATE PRODUCT PER ACRE	PRECAUTIONS (For more information see "Notes on Chemicals" section)
Peas — Postemergence Broadleaf Herbicides			
bentazon	0.84 to 1.08 kg/ha		• Apply POST when peas have at least 3 pairs of leaves.
BASAGRAN (480 g/L)	1.75 to 2.25 L/ha	0.7 to 0.9 L/ac	• Under hot, humid conditions use CITOWETT PLUS or reduce ASSIST oil concentrate to 1 L/ha (0.4 L/ac).
plus surfactant			
CITOWETT PLUS or	2.5 L/1000 L water	2.5 L/1000 L water	• For snow peas, use the low rate of 1.75 L/ha (0.7 L/ac) and apply only once per year.
SUPER SPREADER STICKER	1.25 to 2.5 L/1000 L	1.25 to 2.5L/1000	• Refer to the BASAGRAN label for information on specific weed stage and height.
or oil concentrate		L	• Two applications, 10 days apart, of 1.75 L/ha (0.7 L/ac) may be required for top growth control of nut sedge and Canada thistle, and suppression of field bindweed.
ASSIST	1 to 2 L/ha		
		0.4 to 0.8 L/ac	• **Do NOT** apply if rain is expected within 6 hr. after application.
			• Preharvest interval is 30 days for snow peas.
MCPA	0.38 kg/ha		• Apply POST when peas are 10–15 cm high.
MCPA SODIUM 300 (300 g/L)	1.25 L/ha	0.5 L/ac	• **Do NOT** apply after flower buds have formed on peas.
or MCPA	0.25 kg/ha		• **Do NOT** apply when temperatures are over 27°C, high humidity, or under drought conditions.
MCPA AMINE (500 g/L)	0.5 L/ha	0.2 L/ac	
			• **Do NOT** apply by air.
MCPB/MCPA	1.1 to 1.7 kg/ha		• Apply POST when peas have 3–6 expanded leaves.
TROPOTOX PLUS (400 g/L)	2.75 to 4.25 L/ha	1.1 to 1.7 L/ac	• **Do NOT** apply after the 6–leaf stage as damage may occur.
CLOVITOX PLUS (400 g/L)	2.75 to 4.25 L/ha	1.1 to 1.7 L/ac	• **Do NOT** apply when temperatures are over 27°C, high humidity, or under drought conditions.
			• **Do NOT** apply by air.
			• **Do NOT** graze or cut treated crop for forage.

Peppers

Site Preparation Before Planting – See Chapter 6, Special Methods of Weed Control

All treatments should be applied in 150 to 300 L/ha (60 to 120 L/ac) water.

Discussion of cultural methods can be found in the tomato section. Weed control in peppers is best accomplished by combining chemical and cultural methods.

PREPLANT INCORPORATED (PPI) — Two incorporations at right angles operating at a depth of 10 cm using a double disk (7–10 km/hr) or vibrating shank S-tine cultivator (10–13 km/hr) are required unless otherwise stated. Cultivation-type equipment used for herbicide incorporation is known to spread perennial weeds to previously uninfested areas. Special attention should be directed toward machinery cleanliness, and/or treating fields with perennial weeds last.

Peppers — Soil Applied Grass Herbicides			
trifluralin	0.6 to 1.155 kg/ha		• Apply PPI. Incorporate within 24 hr. of application.
TREFLAN EC(480 g/L)	1.25 to 2.4 L/ha	0.5 to 0.96 L/ac	• **Do NOT** exceed the low rate on medium textured soils.
RIVAL EC (500 g/L)	1.2 to 2.2 L/ha	0.48 to 0.94 L/ac	• **Do NOT** apply to peat or muck soils (> 15% organic matter).
BONANZA 400 (400 g/L)	1.5 to 2.75 L/ha	0.6 to 1.1 L/ac	• **Do NOT** apply to soils with < 2% organic matter.
			• **Do NOT** apply to fields spread with manure within the last 12 months.
			• **Do NOT** apply by air.
			• **Do NOT** apply on the same land for 2 consecutive years.

Peppers — Soil Applied Grass and Broadleaf Herbicides

napropamide	1.12 to 2.25 kg/ha		▪ Apply PPI. Incorporate within 24 hr. of application.
DEVRINOL DF (50 DF)	2.25 to 4.5 kg/ha	0.9 to 1.8 kg/ac	▪ **Do NOT** apply to soils with over 10% organic matter.
			▪ Damage to subsequent cover crops can be reduced by tillage across the rows after harvest. Small grains seeded in the fall may be stunted but not otherwise affected.

Peppers — Postemergence Grass Herbicides

POSTEMERGENCE — Leaf stage of the weeds is critical for good weed control. Smaller weeds are generally easier to kill but there needs to be enough leaf surface to intercept the herbicide. Apply according to recommended leaf stages. Crop stage is important to optimize crop safety. Adjuvants will frequently improve the weed control when used as directed. Weather or other conditions may influence the optimum rate of adjuvant, see the product label for more details. Always use appropriate drift management technology.

sethoxydim	0.15 to 0.5 kg/ha		▪ Apply to actively growing grasses.
POAST ULTRA (450 g/L)	0.32 to 1.1 L/ha	0.13 to 0.45 L/ac	▪ For annual grass, use 0.32 L/ha. Apply at the 1–6 leaf stage.
plus surfactant/solvent			▪ For volunteer grains, use 0.47 L/ha.
MERGE	1 to 2 L/ha	0.4 to 0.8 L/ac	▪ For quackgrass, use 1.1 L/ha. Apply up to the 3–leaf stage. Thorough preplant tillage will ensure more uniform quackgrass emergence. Cultivate after 7 days in wide row crops. Use the high rate of MERGE for quackgrass.
			▪ Use 100–200 L water/ha (40–80 L water/ac).
			▪ Grasses emerging after application will not be controlled.
			▪ Spray tips angled forward 45° will give better coverage.
			▪ **Do NOT** use flood jet or hollow cone nozzles.
			▪ **Do NOT** apply if rain is expected within 1 hr. after application.
			▪ **Do NOT** apply closer than 30 days to harvest.

Potatoes

Site Preparation Before Planting — See Chapter 6, Special Methods of Weed Control

The best weed management system for potatoes uses a combination of chemical weed control with cultivation and other techniques. **See Chapter 1, Principles of Integrated Weed Management**. Cultivation prior to potato emergence using various kinds of cultivation equipment (light harrows, finger weeders, hillers, etc.) will control the early flush of weeds. Root pruning of the crop should be minimized. If the crop is hilled after application of herbicides, untreated soil will surface and another flush of weeds may result.

POTATO VINE KILLING – For information on products and rates of application of vine killing, consult **Publication 363, Vegetable Production Recommendations**, and follow the product label.

PREPLANT INCORPORATED (PPI) — Two incorporations at right angles operating at a depth of 10 cm using a double disk (7–10 km/hr) or vibrating shank S-tine cultivator (10–13 km/hr) are required unless otherwise stated. Cultivation-type equipment used for herbicide incorporation is known to spread perennial weeds to previously uninfested areas. Special attention should be directed toward machinery cleanliness, and/or treating fields with perennial weeds last.

PREEMERGENCE (PRE) — Rainfall at 15–20 mm within 7–10 days after application is necessary to activate preemergence treatments. Shallow cultivation, rotary hoeing or harrowing will control weed escapes and improve herbicide activity in the absence of rainfall.

Potatoes — Soil Applied Grass Herbicides

EPTC	3.4 to 6.8 kg/ha		▪ PPI — Apply to a dry soil surface before planting and incorporate immediately, at next to the last or last cultivation for grass escapes. Use at 1.7 to 2.2 L/ac.
EPTAM (800 g/L)	4.25 to 8.5 L/ha	1.7 to 3.4 L/ac	▪ Avoid wet soil conditions or weed control may be poor.
			▪ Use 2.2 to 3.4 L/ac rates for heavy weed infestations and nut sedge control.

Active Ingredient TRADE NAME Formulation	RATE Active Ingredient PRODUCT PER HA	RATE PRODUCT PER ACRE	PRECAUTIONS For more information see Notes on Chemicals section
s-metolachlor DUAL MAGNUM (915 g/L)	1.14 to 1.6 kg/ha 1.25 to 1.75 L/ha	 0.5 to 0.7 L/ac	• PRE or PPI (for nut sedge control). • **Do NOT** use on the variety Superior. • **Do NOT** on sandy or coarse textured soils low in organic matter. • **Do NOT** apply at ground crack or if potatoes have emerged.
Potatoes — Soil Applied Broadleaf Herbicides			
linuron LOROX DF (50 DF) AFOLAN F (480 g/L) LINURON 480 (480 g/L)	1.1 to 2.25 kg/ha 2.2 to 4.5 kg/ha 2.3 to 4.7 L/ha 2.3 to 4.7 L/ha	 0.88 to 1.8 kg/ac 0.92 to 1.88 L/ac 0.92 to 1.88 L/ac	• PRE — Apply immediately after hilling but the potato tops must be covered with soil to avoid injury. • Use the lower rate on light sandy soils and the higher rate on muck or clay soils.
metobromuron PATORAN FL (400 g/L)	1 to 3.4 kg/ha 2.5 to 8.5 L/ha	 1 to 3.4 L/ac	• PRE — Apply immediately after planting or hilling after potato tops are covered with soil to avoid injury. • POST — before weeds are 2.5 cm tall, and potato tops are not exposed. • Use the lower rate on light sandy soil, although weed control will be reduced. • Use the higher rates on clay and muck soils. • Inter-row cultivation may be necessary for full season control.
metribuzin SENCOR 500 F (500 g/L) or metribuzin LEXONE DF (75 DF) or metribuzin EVICT SOLUPAK (75 DF)	0.6 to 1.1 kg/ha 1.2 to 2.2 L/ha 0.481 to 1.053 kg/ha 0.64 to 1.4 kg/ha 0.41 to 1.16 kg/ha 0.55 to 1.5 kg/ha	 0.48 to 0.88 L/ac 0.25 to 0.56 kg/ac 0.22 to 0.63 kg/ac	• PRE — Apply after hilling before emergence of crop or weeds, or POST before weeds are 4 cm tall. • Use the lower rate on sandy soil. • **Do NOT** use on muck soils. • **Do NOT** use on Belleisle, Tobique, or red skinned varieties. • **Do NOT** exceed a total application rate of 1.12 kg active/ha.
metribuzin SENCOR 75 DF (75 WG) plus linuron LINURON 480 (480 g/L)	0.63 to 0.825 kg/ha 0.84 to 1.1 kg/ha 0.72 to 1.728 kg/ha 1.5 to 3.59 L/ha	 0.34 to 0.44 kg/ac 0.6 to 1.44 L/ac	• PRE — Apply after hilling and before emergence of the crop, or POST before weeds are 4 cm tall. • Use the lower rate on sandy soil. • Use the higher rate on late potatoes for season long control. • **Do NOT** use on muck soils. • **Do NOT** use on Belleisle, Tobique, or red skinned varieties.
monolinuron AFESIN (200 g/L)	1.1 to 2.2 kg/ha 5.5 to 11 L/ha	 2.2 to 4.4 L/ac	• PRE — Apply immediately after hilling but all the potato tops must be covered with soil to avoid injury. • Use the lower rate on soils low in organic matter. • Use the higher rate on clay or soils high in organic matter.
Potatoes — Soil Applied Grass and Broadleaf Herbicides			
EPTC EPTAM (800 g/L) plus metribuzin SENCOR 500 F (500 g/L) or metribuzin LEXONE DF (75 DF) or metribuzin EVICT SOLUPAK (75 DF)	3.4 to 4.4 kg/ha 4.25 to 5.5 L/ha 0.55 to 0.875 kg/ha 1.1 to 1.75 L/ha 0.624 to 0.902 kg/ha 0.83 to 1.2 kg/ha 0.56 to 0.83 kg/ha 0.75 to 1.1 kg/ha	 1.7 to 2.2 L/ac 0.44 to 0.7 L/ac 0.33 to 0.48 kg/ac 0.3 to 0.44 kg/ac	• PPI. • Apply as a tank-mix in 220 to 330 L/ha (88 to 132 L/ac) water and incorporate immediately. • **Do NOT** use on muck soils. • **Do NOT** use on Belleisle or Tobique varieties. • May be applied through the irrigation.

s-metolachlor DUAL MAGNUM (915 g/L) plus linuron LOROX DF (50 DF) AFOLAN F (480 g/L) LINURON 480 (480 g/L)	1.14 to 1.6 kg/ha 1.25 to 1.75 L/ha 0.88 to 1.12 kg/ha 1.75 to 2.25 kg/ha 1.8 to 2.3 L/ha 1.8 to 2.3 L/ha	 0.5 to 0.7 L/ac 0.7 to 0.9 kg/ac 0.72 to 0.92 L/ac 0.72 to 0.92 L/ac	• PRE — Apply after the first hilling before emergence of the crop and weeds. • See Precautions for DUAL MAGNUM and for linuron.
s-metolachlor DUAL MAGNUM (915 g/L) plus metobromuron PATORAN FL (400 g/L)	1.14 to 1.6 kg/ha 1.25 to 1.75 L/ha 1.168 to 1.68 kg/ha 2.92 to 4.2 L/ha	 0.5 to 0.7 L/ac 1.17 to 1.68 L/ac	• PRE — Apply after the first hilling before emergence of the crop and weeds. • See Precautions for DUAL MAGNUM. • Use the lower rates on sandy soil.
s-metolachlor DUAL MAGNUM (915 g/L) plus metribuzin SENCOR 500 F (500 g/L) or metribuzin EVICT SOLUPAK (75 DF) or metribuzin LEXONE DF (75 DF)	1.14 to 1.6 kg/ha 1.25 to 1.75 L/ha 0.55 to 1.125 kg/ha 1.1 to 2.25 L/ha 0.56 to 1.16 kg/ha 0.75 to 1.5 kg/ha 0.624 to 0.902 kg/ha 0.83 to 1.2 kg/ha	 0.5 to 0.7 L/ac 0.44 to 0.9 L/ac 0.3 to 0.63 kg/ac 0.33 to 0.48 kg/ac	• PPI or PRE — Apply after the first hilling before emergence of the crop and weeds. • See Precautions for DUAL MAGNUM. • **Do NOT** use on Superior, Belleisle, or Tobique potatoes. • **Do NOT** apply on sandy or on coarse textured soils low in organic matter, or on muck soils. • **Do NOT** apply at ground crack or if potatoes have emerged.
s-metolachlor DUAL MAGNUM (915 g/L) plus monolinuron AFESIN (200 g/L)	1.14 to 1.6 kg/ha 1.25 to 1.75 L/ha 1.1 to 1.7 kg/ha 5.5 to 8.5 L/ha	 0.5 to 0.7 L/ac 2.2 to 3.4 L/ac	• PRE — Apply after the first hilling before emergence of the crop and weeds. • See Precautions for DUAL MAGNUM.
Potatoes — Burndown and Soil Applied Grass and Broadleaf Herbicide Tank-mix Options			
glufosinate ammonium IGNITE (150 g/L)	0.405 to 0.75 kg/ha 2.7 to 5 L/ha	 1.08 to 2 L/ac	• Apply uniformly in 110–330 L/ha (44–132 L/ac) of water at no later than ground crack of the crop. • Only emerged weeds will be controlled.
glufosinate ammonium IGNITE (150 g/L) plus metribuzin SENCOR 500 F (500 g/L) LEXONE DF (75 DF)	0.405 to 0.75 kg/ha 2.7 to 5 L/ha 0.55 kg/ha 1.1 L/ha 0.75 kg/ha	 1.08 to 2 L/ac 0.44 L/ac 0.3 kg/ac	• POST – Apply uniformly in 110–330 L/ha (44–132 L/ac) of water at no later than ground crack of the crop. • Only emerged weeds will be controlled. • **Do NOT** use metribuzin on muck soils or on Belleisle or Tobique varieties.
paraquat GRAMOXONE (200 g/L)	0.6 to 0.85 kg/ha 3 to 4.25 L/ha	 1.2 to 1.7 L/ac	• Apply in 275–550 L/ha (150–220 L/ac) water to emerged weeds. • Use on Netted Gem and Cherokee varieties before emergence. Apply on other varieties until 25%–30% of the crop has emerged but none of the tops should be over 5–8 cm in height. Temporary yellowing on the tops will occur. • **Do NOT** use on emerged potato plants in the evening, under cloudy conditions or when the plants are under moisture stress.

Potatoes — Postemergence Grass Herbicides

POSTEMERGENCE — Leaf stage of the weeds is critical for good weed control. Smaller weeds are generally easier to kill but there needs to be enough leaf surface to intercept the herbicide. Apply according to recommended leaf stages. Crop stage is important to optimize crop safety. Adjuvants will frequently improve the weed control when used as directed. Weather or other conditions may influence the optimum rate of adjuvant, see the product label for more details. Always use appropriate drift management technology.

RATE NAME, Formulation	RATE (active ingredient) PRODUCT PER HA	RATE PRODUCT PER ACRE	PRECAUTIONS For more information see "Notes on Chemicals" section
clethodim SELECT (240 g/L) plus surfactant AMIGO	0.03 to 0.09 kg/ha 0.13 to 0.38 L/ha 0.5 to 1% v/v 5 to 10 L/1000 L water	 0.05 to 0.15 L/ac 0.5 to 1% v/v 5 to 10 L/1000 L water	• Potatoes are tolerant at any growth stage. • For annual grasses and volunteer cereals, apply at the 2–6 leaf stage. • For quackgrass, apply at the 2–5 leaf stage at the higher rate.
diclofop-methyl HOE-GRASS 284 (284 g/L)	1 kg/ha 3.5 L/ha	 1.4 L/ac	• **Do NOT** tank-mix with other herbicides. • Apply when the majority of the grass weeds are in the 2–3 leaf stage. • **Do NOT** apply if rain is expected within 1 hr. of application. • **Do NOT** apply other postemergence herbicides for 4 days before or after application.
fenoxaprop-p-ethyl EXCEL SUPER (80.5 g/L)	0.054 kg/ha 0.67 L/ha	 0.27 L/ac	• Apply when majority of annual grasses are in the 1–6 leaf stage or until volunteer corn is up to 25 cm tall. • **Do NOT** apply if rainfall is expected within 1 hr. after application. • Grasses emerging after application will not be controlled.
fluazifop-p-butyl VENTURE L (125 g/L)	0.075 to 0.25 kg/ha 0.6 to 2 L/ha	 0.24 to 0.9 L/ac	• Apply to actively growing grasses before tillering. • Apply at 0.6 L/ha (0.24 L/ac) at 2–5 leaf stage of annual grasses (2–4 leaf for foxtails). • Apply at 0.8 L/ha (0.32 L/ac) at 2–5 leaf stage of volunteer wheat and barley. • Apply at 2 L/ha (0.8 L/ac) at 3–5 leaf stage of quackgrass & wirestem muhly. • Apply in a maximum volume of 300 L/ha (120 L/ac). • Thorough preplant tillage, fragmenting quackgrass rhizomes improves control • **Do NOT** cultivate between rows until 5 days after application. • **Do NOT** apply closer than 90 days to harvest. • May be tank-mixed with metribuzin.
sethoxydim POAST ULTRA (450 g/L) surfactant/solvent MERGE	0.15 to 0.5 kg/ha 0.32 to 1.1 L/ha 1 to 2 L/ha	 0.13 to 0.45 L/ac 0.4 to 0.8 L/ac	• Apply to actively growing grasses. • For annual grass, use 0.32 L/ha. Apply at the 1–6 leaf stage. • For volunteer grains, use 0.47 L/ha. • For quackgrass, use 1.1 L/ha. Apply up to the 3–leaf stage. Thorough preplant tillage will ensure more uniform quackgrass emergence. Cultivate after 7 days in wide row crops. Use the high rate of MERGE for quackgrass. • Use 100–200 L water/ha (40–80 L water/ac). • **Do NOT** apply closer than 80 days to harvest.
Potatoes — Postemergence Grass and Broadleaf Herbicides			
metribuzin SENCOR 500 F (500 g/L) or metribuzin LEXONE DF (75 DF) or metribuzin EVICT SOLUPAK (75 DF)	0.6 to 1.1 kg/ha 1.2 to 2.2 L/ha 0.624 to 0.772 kg/ha 0.83 to 1.03 kg/ha 0.41 to 1.16 kg/ha 0.55 to 1.5 kg/ha	 0.48 to 0.88 L/ac 0.33 to 0.4 kg/ac 0.22 to 0.63 kg/ac	• Apply soon after potatoes emerge, and before weeds are 4 cm high. • Apply in the afternoon or early evening on sunny days to allows the enzyme that detoxifies metribuzin to build-up. • **Do NOT** use on red skinned varieties • **Do NOT** use on potatoes grown for the early market. • **Do NOT** use on Shepody or Atlantic potatoes. • **Do NOT** use on muck soil to avoid injury on subsequent crops.

rimsulfuron	15 g/ha		• Apply when quackgrass is at 3–6 leaf stage (less than 10 cm tall), annual grasses are at 1–6 leaf stage and redroot pigweed is in the 4–6 leaf stage.
PRISM (25DF)	60 g/ha	24 g/ac	• Apply before potatoes initiate flowering.
plus non-ionic surfactant	0.2% v/v	0.2% v/v	• **Do NOT** apply within 30 days of harvest.
CITOWETT PLUS, AGRAL 90 or AG-SURF	2L/1000 L water	2L/1000 L water	• Always add water soluble packages to clean water with the agitator running.

Rutabagas

Site Preparation Before Planting — See Chapter 6, Special Methods of Weed Control

PREPLANT INCORPORATED (PPI) — Two incorporations at right angles operating at a depth of 10 cm using a double disk (7–10 km/hr) or vibrating shank S-tine cultivator (10–13 km/hr) are required unless otherwise stated. Cultivation-type equipment used for herbicide incorporation is known to spread perennial weeds to previously uninfested areas. Special attention should be directed toward machinery cleanliness, and/or treating fields with perennial weeds last.

PREEMERGENCE (PRE) — Rainfall of 15–20 mm within 7–10 days after application is necessary to activate preemergence treatments. Shallow cultivation, rotary hoeing or harrowing will control weed escapes and improves herbicide activity in the absence of rainfall.

Rutabagas — Soil Applied Grass Herbicides

s-metolachlor	1.14 to 1.6 kg/ha		• Apply PPI or PRE. PPI gives optimal control of yellow nut sedge; PRE gives optimal control of Eastern black nightshade.
DUAL MAGNUM (915 g/L)	1.25 to 1.75 L/ha	0.5 to 0.7 L/ac	• **Do NOT** use on muck, peat, high organic matter soils.
			• **Do NOT** use on soils with less than 1% organic matter.
			• Use the higher rate for heavier weed populations.
			• Apply by ground application equipment only.
trifluralin	0.6 to 1.155 kg/ha		• Apply PPI. Incorporate within 24 hr. of application.
TREFLAN EC (450 g/L)	1.25 to 2.4 L/ha	0.5 to 0.96 L/ac	• **Do NOT** exceed the low rate on medium textured soils.
RIVAL EC (500 g/L)	1.2 to 2.2 L/ha	0.48 to 0.94 L/ac	• **Do NOT** apply to peat or muck soils (> 15% organic matter).
BONANZA 400 (400 g/L)	1.5 to 2.75 L/ha	0.6 to 1.1 L/ac	• **Do NOT** apply to soils with < 2% organic matter.
			• **Do NOT** apply to fields spread with manure within the last 12 months.
			• **Do NOT** apply by air.
			• **Do NOT** apply on the same land for 2 consecutive years.

Rutabagas — Soil Applied Grass and Broadleaf Herbicides

napropamide	1.12 to 2.25 kg/ha		• Apply PPI. Incorporate within 24 hr. of application.
DEVRINOL DF (50 DF)	2.25 to 4.5 kg/ha	0.9 to 1.8 kg/ac	• Use the lower rate on sandy soils.
			• **Do NOT** apply to soils with over 10% organic matter.
			• Damage to subsequent cover crops can be reduced by tillage across the rows after harvest.
			• Preharvest interval is 60 days.

Rutabagas — Postemergence Grass Herbicides

POSTEMERGENCE — Leaf stage of the weeds is critical for good weed control. Smaller weeds are generally easier to kill but there needs to be enough leaf surface to intercept the herbicide. Apply according to recommended leaf stages. Crop stage is important to optimize crop safety. Adjuvants will frequently improve the weed control when used as directed. Weather or other conditions may influence the optimum rate of adjuvant, see the product label for more details. Always use appropriate drift management technology.

TRADE NAME	RATE PRODUCT PER HA	RATE PRODUCT PER ACRE	PRECAUTIONS For more information, see "Notes on Chemicals" section
fluazifop-p-butyl VENTURE L (125 g/L)	0.075 to 0.25 kg/ha 0.6 to 2 L/ha	 0.24 to 0.8 L/ac	▪ Apply POST to actively growing grasses before tillering. ▪ Apply at 0.6 L/ha (0.24 L/ac) at 2–5 leaf stage of annual grasses (2–4 leaf for foxtails). ▪ Apply at 0.8 L/ha (0.32 L/ac) at 2–5 leaf stage of volunteer wheat and barley. ▪ Apply at 2 L/ha (0.8 L/ac) at 3–5 leaf stage of quackgrass & wirestem muhly. Thorough preplant tillage will ensure more uniform emergence. Cultivate 7 days after treatment in wide row crops. ▪ Apply in a maximum volume of 300 L/ha (120 L/ac). ▪ **Do NOT** cultivate between rows until 5 days after application. ▪ Apply **ONLY** once per season. ▪ **Do NOT** apply other herbicides within 3 days of VENTURE L application. ▪ **Do NOT** apply if rain is expected within 2 hr. after application. ▪ Preharvest interval is 45 days.
Broadleaves — Postemergent Broadleaf Herbicides			
clopyralid LONTREL 360 (360 g/L)	0.2 kg/ha 0.56 L/ha	 0.22 L/ac	▪ Apply POST when ragweed is 5–10 cm tall. ▪ Make **ONLY** one application per year. ▪ **Do NOT** apply by air. ▪ **Do NOT** apply if rain is expected within 4 hr. after application. ▪ Preharvest interval is 83 days.

Specialty Vegetables — Chinese broccoli, radish & cabbage, kohlrabi, mustard cabbage, fuzzy squash, snow peas

Site Preparation Before Planting — See Chapter 6, Special Methods of Weed Control

PREPLANT INCORPORATED (PPI) — Two incorporations at right angles operating at a depth of 10 cm using a double disk (7–10 km/hr) or vibrating shank S-tine cultivator (10–13 km/hr) are required unless otherwise stated. Cultivation-type equipment used for herbicide incorporation is known to spread perennial weeds to previously uninfested areas. Special attention should be directed toward machinery cleanliness, and/or treating fields with perennial weeds last.

PREEMERGENCE (PRE) — Rainfall at 15–20 mm within 7–10 days after application is necessary to activate preemergence treatments. Shallow cultivation, rotary hoeing or harrowing will control weed escapes and improve herbicide activity in the absence of rainfall.

Specialty Vegetables — Soil Applied Grass and Broadleaf Herbicides

imazethapyr PURSUIT (240 g/L)	0.075 kg/ha 0.312 L/ha	 0.125 L/ac	▪ PRE — For use on snow peas **ONLY**. ▪ Apply **ONLY** once per year. ▪ Apply in 200 L/ha (80 L/ac). ▪ **Do NOT** apply closer than 60 days to harvest.
napropamide DEVRINOL DF (50 DF)	1.12 to 2.25 kg/ha 2.25 to 4.5 kg/ha	 0.9 to 1.8 kg/ac	▪ PRE or PREPLANT — For use **ONLY** on seeded Chinese broccoli, mustard, cabbage, Chinese radish, Chinese cabbage, transplanted Chinese cabbage and kohlrabi. ▪ Use the lower rate on light soils (coarse textured to sandy and sandy loam). ▪ One application per year. ground **ONLY.** ▪ **Do NOT** apply closer than 60 days to harvest. ▪ After harvest, soil should be worked (across rows if banded) to prevent injury to succeeding crops. ▪ Small grains seeded in the fall may be stunted but not otherwise affected.

napropamide DEVRINOL DF (50 DF)	1.5 kg/ha 3 kg/ha	 1.2 kg/ac	• PPI — For use on fuzzy squash **ONLY**. • Requires rainfall or sufficient irrigation to wet the soil to a depth of 5–10 cm soon after application. • Some crop stunting may be observed but this should not affect yield.

Specialty Vegetables — Postemergence Grass Herbicides

POSTEMERGENCE — Leaf stage of the weeds is critical for good weed control. Smaller weeds are generally easier to kill but there needs to be enough leaf surface to intercept the herbicide. Apply according to recommended leaf stages. Crop stage is important to optimize crop safety. Adjuvants will frequently improve the weed control when used as directed. Weather or other conditions may influence the optimum rate of adjuvant, see the product label for more details. Always use appropriate drift management technology.

sethoxydim POAST ULTRA (450 g/L) plus surfactant/solvent MERGE	0.15 to 0.5 kg/ha 0.32 to 1.1 L/ha 1 to 2 L/ha	 0.13 to 0.45 L/ac 0.4 to 0.8 L/ac	• For use **ONLY** on Chinese broccoli, Chinese cabbage, kohlrabi, mustard cabbage and Chinese radish. • Apply to actively growing grasses. • Apply using 110 to 200 L/ha (44 to 80 L/ac) water volume. • For annual grass, use 0.32 L/ha. Apply at the 1–6 leaf stage. • For volunteer grains, use 0.47 L/ha. • For quackgrass, use 1.1 L/ha. Apply up to the 3–leaf stage. Thorough preplant tillage will ensure more uniform quackgrass emergence. Cultivate after 7 days in wide row crops. Use the high rate of MERGE for quackgrass. • **Do NOT** apply closer than 30 days to harvest.

Specialty Vegetables — Postemergent Broadleaf Herbicides

bentazon BASAGRAN (480 g/L) plus oil concentrate ASSIST	0.84 kg/ha 1.75 L/ha 1 to 2 L/ha	 0.7 L/ac 0.4 to 0.8 L/ac	• For Snow Peas **ONLY**. • Apply after the crop is at the 3–leaf stage when weeds are small and actively growing. • Use **ONLY** one application per year. • Apply in 300 L water/ha. • **Do NOT** apply closer than 30 days to harvest.
clopyralid LONTREL 360 (360 g/L)	0.20 kg/ha 0.56 L/ha	 0.2 L/ac	• For use **ONLY** on Nappa Cabbage, Chinese Radish, Mustard Cabbage, and Chinese Broccoli. • Treat when weeds are young and actively growing. • Apply as a ground application in 300 L water/ha. • Use **ONLY** one application per year. • **Do NOT** apply closer than 30 days to harvest. • Will not control weeds that emerge after treatment.

Spinach

Site Preparation Before Planting — See Chapter 6, Special Methods of Weed Control

PREPLANT INCORPORATED (PPI) — Two incorporations at right angles operating at a depth of 10 cm using a double disk (7–10 km/hr) or vibrating shank S-tine cultivator (10 to 13 km/hr) are required unless otherwise stated. Cultivation-type equipment used for herbicide incorporation is known to spread perennial weeds to previously uninfested areas. Special attention should be directed toward machinery cleanliness, and/or treating fields with perennial weeds last.

PREEMERGENCE (PRE) — Rainfall of 15–20 mm within 7–10 days after application is necessary to activate preemergence treatments. Shallow cultivation, rotary hoeing or harrowing will control weed escapes

Active ingredient TRADE NAME (Formulation)	RATE PRODUCT PER HA	RATE PRODUCT PER ACRE	PRECAUTIONS (For more information see "Notes on Chemicals" section)
[illegible]			
cycloate RO-NEET (720 g/L)	3.4 kg/ha 4.75 L/ha	 1.9 L/ac	• PPI — on mineral soils only. • Apply to a dry soil surface before planting, and incorporated within 10 min with a double disk, followed soon by a second incorporation at right angles.
[illegible]			
chlorpropham CIPC EC (480 g/L)	1.3 to 5 kg/ha 2.7 to 10.4 L/ha	 1.08 to 4.16 L/ac	• PRE — on mineral soils only. • Use higher rates during warm weather (May 1 to October 15) and on heavy soils. • Use lower rates during cool season (October 15 to May 1) and on sandy loam soils.
[illegible]			
sethoxydim POAST ULTRA (450 g/L) plus surfactant/solvent MERGE	0.15 to 0.5 kg/ha 0.32 to 1.1 L/ha 1 to 2 L/ha	 0.13 to 0.45 L/ac 0.4 to 0.8 L/ac	• Apply to actively growing grasses. • For annual grass, use 0.32 L/ha. Apply at the 1–6 leaf stage (2–5 is optimum). • For volunteer grains, use 0.47 L/ha. Apply at the 1–6 leaf stage (2–5 is optimum). • For quackgrass, use 1.1 L/ha. Apply up to the 3–leaf stage. Thorough preplant tillage will ensure more uniform quackgrass emergence. Cultivate after 7 days in wide row crops. Use the high rate of MERGE for quackgrass. • Use 100–200 L water/ha (40–80 L water/ac). • Grasses emerging after application will not be controlled. • Spray tips angled forward 45° will give better coverage. • **Do NOT** use flood jet or hollow cone nozzles. • **Do NOT** apply if rain is expected within 1 hr. after application. • Preharvest interval is 49 days.

Sugar beets (Processing)

Caution about Herbicide Residues — Sugar beets are one of most sensitive crops to herbicide residues from the previous year's crop. They are particularly sensitive to residues from many of the Group 2 herbicides, including Pursuit, Broadstrike, Classic and Peak. Low soil pH (below 6.0) or high soil pH (above 7. 5) can be a factor to delay the breakdown of these herbicides, increasing crop injury in rotational crops. Please see **Table 2, Herbicide Crop Rotation and Soil pH Restrictions**, as well as product labels and your herbicide and sugar company representatives for more details on your situation.

[illegible] — See Chapter 6, Special Methods of Weed Control

PREPLANT INCORPORATED (PPI) — Two incorporations at right angles operating at a depth of 10 cm using a double disk (7–10 km/hr) or vibrating shank S-tine cultivator (10–13 km/hr) are required unless otherwise stated. Cultivation-type equipment used for herbicide incorporation is known to spread perennial weeds to previously uninfested areas. Special attention should be directed toward machinery cleanliness, and/or treating fields with perennial weeds last.

PREEMERGENCE (PRE) — Rainfall of 15–20 mm within 7–10 days after application is necessary to activate preemergence treatments. Shallow cultivation, rotary hoeing or harrowing will control weed escapes and improve herbicide activity in the absence of rainfall.

[illegible] — Soil Applied Grass Herbicides

cycloate RO-NEET (720 g/L)	4.5 to 5.58 kg/ha 6.25 to 7.75 L/ha	 2.5 to 3.1 L/ac	• Apply PPI and incorporate immediately. • Use lower rate on light sandy soil, and higher rate on heavier soil. • Use **ONLY** on mineral soils.

Sugar beets (Processing) — Soil Applied Broadleaf Herbicides			
pyrazon PYRAMIN FL (430 g/L)	3.55 to 4.41 kg/ha 8.25 to 10.25 L/ha	 3.3 to 4.1 L/ac	▪ Apply PPI or PRE. ▪ **Do NOT** incorporate more than 5 cm deep. ▪ **Do NOT** apply to soils with less than 3% organic matter.
Sugar beets (Processing) — Soil Applied Grass and Broadleaf Herbicides			
ethofumesate NORTRON SC (480 g/L)	1.54 to 3.96 kg/ha 3.2 to 8.25 L/ha	 1.28 to 3.3 L/ac	▪ Apply PPI or PRE. ▪ **Do NOT** incorporate more than 5 cm deep. ▪ Use **ONLY** on mineral soils. ▪ Use the lower rate on soils with < 3% organic matter. ▪ **Do NOT** rotate to other crops for 12 months.
ethofumesate NORTRON SC (480 g/L) plus cycloate RO-NEET (720 g/L)	1.41 to 2.88 kg/ha 3.5 to 6 L/ha 2.70 to 3.78 kg/ha 3.75 to 5.25 L/ha	 1.4 to 2.4 L/ac 1.5 to 2.1 L/ac	▪ Apply PPI and incorporate immediately. ▪ **Do NOT** incorporate more than 5 cm deep. ▪ Use **ONLY** on mineral soils. ▪ Use the lower rate on soils with < 3% organic matter. ▪ **Do NOT** rotate to crops other than sugar beets for 12 months.
pebulate TILLAM (720 g/L)	4.5 to 6.66 kg/ha 6.25 to 9.25 L/ha	 2.8 to 3.7 L/ac	▪ PPI – Apply to a dry soil surface before planting and incorporated. ▪ Apply in 150–300 L water/ha. ▪ Use on mineral soils **ONLY**. Not usually effective on highly organic soils. ▪ Use lower rate on sandy soils.
pyrazon PYRAMIN FL (430 g/L) plus ethofumesate NORTRON SC (480 g/L)	2.26 kg/ha 5.25 L/ha 1.75 kg/ha 3.65 L/ha	 2.1 L/ac 1.46 L/ac	▪ Apply PRE. ▪ **Do NOT** apply to soil with < 2% organic matter. ▪ Apply **ONLY** once per year. ▪ Use **ONLY** on mineral soils. ▪ **Do NOT** rotate to crops other than sugar beets for 12 months.
Sugar beets (Processing) — Postemergence Grass Herbicides			
POSTEMERGENCE — Leaf stage of the weeds is critical for good weed control. Smaller weeds are generally easier to kill but there needs to be enough leaf surface to intercept the herbicide. Apply according to recommended leaf stages. Crop stage is important to optimize crop safety. Adjuvants will frequently improve the weed control when used as directed. Weather or other conditions may influence the optimum rate of adjuvant, see the product label for more details. Always use appropriate drift management technology.			
quizalofop-p-ethyl ASSURE II (96 g/L) plus oil concentrate CANPLUS 411 or SURE-MIX	0.036 to 0.072 kg/ha 0.38 to 0.75 L/ha 5 to 10 L/1000 L water 5 L/1000 L water	 0.15 to 0.30 L/ac 5 to 10 L/1000 L water 5 L/1000 L water	▪ Apply POST when annual grasses and volunteer cereals are in the 2 leaf to tillering stage and volunteer corn and quackgrass are in the 2–6 leaf stages. ▪ Apply before the crop canopy closes to maximize spray coverage. ▪ Use the 0.38 L/ha (0.15 L/ac) rate for annual grasses and volunteer cereals. ▪ Use the 0.75 L/ha (0.30 L/ac) rate for quack grass. ▪ Use a second application of 0.38 L/ha (0.15 L/ac) control late emerging weeds. ▪ **Do NOT** exceed an accumulative seasonal use rate of 0.75 L/ha (0.30 L/ac). ▪ **Do NOT** use flood jet nozzles. ▪ **Do NOT** apply if rain is expected within 1 hr. after application. ▪ Preharvest interval is 80 days.

Active ingredient TRADE NAME Formulation	RATE active ingredient PRODUCT PER HA	RATE PRODUCT PER ACRE	PRECAUTIONS For more information see "Notes on Chemicals" section
sethoxydim POAST ULTRA (450 g/L) plus surfactant/solvent MERGE	0.15 to 0.5 kg/ha 0.32 to 1.1 L/ha 1 to 2 L/ha	 0.13 to 0.45 L/ac 0.4 to 0.8 L/ac	• Apply POST to actively growing grasses. • For annual grass, use 0.32 L/ha. Apply at the 1–6 leaf stage (2–5 is optimum). • For volunteer grains, use 0.47 L/ha. Apply at the 1–6 leaf stage (2–5 is optimum). • For quackgrass, use 1.1 L/ha. Apply up to the 3–leaf stage. Thorough preplant tillage will ensure more uniform quackgrass emergence. Cultivate after 7 days in wide row crops. Use the high rate of MERGE for quackgrass. • Use 100–200 L water/ha (40–80 L water/ac). • Grasses emerging after application will not be controlled. • **Do NOT** graze treated crop. • Spray tips angled forward 45° will give better coverage. • **Do NOT** use flood jet or hollow cone nozzles. • **Do NOT** apply if rain is expected within 1 hr. after application. • **Do NOT** apply herbicides other than LONTREL 360 within 4 days of application. • **Do NOT** apply if rain is expected within 1 hr. after application. • Preharvest interval is 85 days.
Sugar beets (Processing) — Postemergence Broadleaf Herbicides			
clopyralid LONTREL 360 (360 g/L)	Consult label and your processor for application rates		• Apply POST when sugar beets are in the cotyledon to 8–leaf stage. • Preharvest interval is 90 days.
desmedipham BETANEX (150 g/L)	Consult label and your processor for application rates		• Apply POST when sugar beets have at least 2 true leaves. • Apply before the weeds have 4 true leaves (before 2 true leaves is optimum). • Wait a minimum of 7 days before making a second application. • Consult label for split (reduced rate) applications. • **Do NOT** spray in excess of a total of 16.5 L/ha of BETANEX per year. • **Do NOT** spray under extreme temperatures or drought conditions. • **Do NOT** spray if dew is present. • Yellowing of the crop may occur, but sugar beets will recover. • **Do NOT** spray if rainfall is expected within 6 hr. • Preharvest interval is 60 days.
pyrazon PYRAMIN FL (430 g/L) plus surfactant CITOWETT PLUS	Consult label and your processor for application rates		• Apply POST when true leaf of sugar beets is at least 2.5 cm long. • Apply before the weeds have 3 true leaves. • **Do NOT** use on soils with < 3% organic matter. • Avoid hot temperatures. • Apply using a minimum of 300 L/ha of water.

triflusulfuron-methyl UPBEET (50 DF) plus desmedipham/phenmedipham BETAMIX ((1:1) 150 g/L)	17.5 to 35 g/ha 35 to 70 g/ha 0.26 to 0.53 kg/ha 1.75 to 3.5 L/ha	 14 to 28 g/ac 0.7 to 1.4 L/ac	• Apply POST when sugar beets are actively growing. • Yellowing of the crop may occur, but sugar beets will recover. • Make 2 applications 5–10 days apart, or as weeds emerge, to weeds with fewer than 4 leaves. Best control is obtained if weeds have less than 2 leaves. • Use the closer sequential if the first application was applied to 5 cm (4 true leaves) weeds. • Use the higher rate for larger weeds and heavy weed populations. • If velvetleaf is the predominant weed, use of UPBEET alone with adjuvant is preferable. • **Do NOT** use an adjuvant with this tank-mix. • **Do NOT** use more than 100 g/ha (40 g/ac) of UPBEET in a season. • Avoid hot temperatures. • **Do NOT** apply under drought conditions. • **Do NOT** apply while dew is present. • **Do NOT** spray if rainfall is expected within 6 hr. • Preharvest interval is 60 days.
triflusulfuron-methyl UPBEET (50 DF) plus non-ionic surfactant AGRAL 90, AG-SURF or CITOWETT PLUS or plus adjuvant SURE-MIX	17.5 to 35 g/ha 35 to 70 g/ha 0.25% v/v 2.5 L/1000 L water 0.25% v/v 2.5 L/1000 L water	 14 to 28 g/ac 2.5 L/1000 L water 2.5 L/1000 L water	• Apply POST when sugar beets are actively growing. • Yellowing of the crop may occur, but sugar beets will recover. • Make 2 applications 5–10 days apart when velvetleaf has fewer than 2 leaves. • Use the higher rate for larger weeds and heavy weed populations. • **Do NOT** use more than 100 g/ha (40 g/ac) of UPBEET in a season. • **Do NOT** apply under extreme temperatures or drought conditions. • **Do NOT** spray if rainfall is expected within 6 hr. • Preharvest interval is 60 days.
Sugar beets (Processing) — Postemergence Grass and Broadleaf Herbicides			
desmedipham/phenmedipham (1:1) BETAMIX (75 g/L: 75 g/L)	Consult label and your processor for application rates		• Apply POST when sugar beets have at least 2 true leaves. • Yellowing of the crop may occur, but sugar beets will recover. • Best weed control when weeds have fewer than 2 true leaves. • A second application may be made if required. Wait at least 7 days. • Consult label for split (reduced rate) applications. • **Do NOT** spray in excess of a total of 16.5 L/ha of BETAMIX per year. • **Do NOT** apply under extreme temperatures or drought conditions • **Do NOT** apply while dew is present. • **Do NOT** spray if rainfall is expected within 6 hr. • Preharvest interval is 60 days.

Active ingredient TRADE NAME Formulation	RATE active ingredient PRODUCT PER HA	RATE PRODUCT PER ACRE	PRECAUTIONS For more information see "Notes on Chemicals" section
desmedipham/phenmedipham (1:1) BETAMIX (75 g/L: 75 g/L) plus endothall HERBICIDE 273 (360 g/L)	Consult label and your processor for application rates		• Apply POST when sugar beets have 4–6 true leaves. • Best weed control when weeds have fewer than 2 true leaves. • Use lower rate on light, sandy soils. • Use the lower rate on smaller sugar beets or sugar beets under stress. • Apply when average temperature is higher than 15 °C for best results. • **Do NOT** apply under extreme temperatures or drought conditions. • **Do NOT** apply while dew is present. • Yellowing of the crop may occur, but sugar beets will recover. • **Do NOT** apply if rainfall is expected within 6 hr. • Preharvest interval is 90 days.
endothall HERBICIDE 273 (360 g/L)	Consult label and your processor for application rates		• Apply POST when sugar beets are in the 4–6 leaf stages. • Best weed control when weeds have fewer than 2 true leaves. • Use lower rate on light, sandy soils. • Yellowing of the crop may occur, but sugar beets will recover. • Apply when average temperature is higher than 15°C for best results. • **Do NOT** apply later than 40 days after emergence.

Sweet Potatoes

Site Preparation Before Planting — See Chapter 6, Special Methods of Weed Control

Sweet Potatoes — Postemergence Grass Herbicides

POSTEMERGENCE — Leaf stage of the weeds is critical for good weed control. Smaller weeds are generally easier to kill but there needs to be enough leaf surface to intercept the herbicide. Apply according to recommended leaf stages. Crop stage is important to optimize crop safety. Adjuvants will frequently improve the weed control when used as directed. Weather or other conditions may influence the optimum rate of adjuvant, see the product label for more details. Always use appropriate drift management technology.

sethoxydim POAST ULTRA (450 g/L) plus surfactant/solvent MERGE	0.15 to 0.5 kg/ha 0.32 to 1.1 L/ha 1.0 to 2.0 L/ha	 0.13 to 0.45 L/ac 0.4 to 0.8 L/ac	• Apply to actively growing grasses. • Apply using 110–200 L/ha (44–80 L/ac) water volume. • For annual grass, use 0.32 L/ha. Apply at the 1–6 leaf stage. • For volunteer grains, use 0.47 L/ha. • For quackgrass, use 1.1 L/ha. Apply up to the 3–leaf stage. Thorough preplant tillage will ensure more uniform quackgrass emergence. Cultivate after 7 days in wide row crops. Use the high rate of MERGE for quackgrass. • **Do NOT** apply closer than 30 days to harvest.

Tomatoes (Transplanted)

Weed control in tomatoes usually consists of a combination of chemical weed control and cultivation. Crop rotation is also beneficial in the control of weeds. Cultivation should be shallow to prevent bringing untreated soil to the surface, which may result in another flush of weeds. When tomatoes are grown on raised beds and beds are reshaped during the course of the season, it may be necessary or useful to apply another herbicide treatment to areas between the rows to prevent a new weed infestation from interfering with harvesting. Do not exceed the total recommended rate per season of any herbicide applied more than once per year. Band treatment of herbicides over the row will reduce the cost by one-half to two-thirds depending on the width of the band compared to the row spacing. Shallow inter-row cultivation will be required for weed control between the rows.

Perennial weeds may be partially controlled by cultivation. Controlling them in crops other than tomatoes when grown in rotation is the best approach to perennial weed control. Perennials are easily spread with cultivators or tillage equipment. Till areas of perennial weeds last. Machinery sanitation is important when moving from between fields.

Site Preparation Before Planting — See Chapter 6, Special Methods of Weed Control

All treatments should be applied in 150–300 L/ha (60–120 L/ac) water unless otherwise specified.

PREPLANT INCORPORATED (PPI) – Two incorporations at right angles operating at a depth of 10 cm using a double disk (7–10 km/hr) or vibrating shank S-tine cultivator (10–13 km/hr) are required unless otherwise stated. Cultivation-type equipment used for herbicide incorporation is known to spread perennial weeds to previously uninfested areas. Special attention should be directed toward machinery cleanliness, and/or treating fields with perennial weeds last.

Tomatoes (Transplanted) — Soil Applied Grass Herbicides

s-metolachlor DUAL MAGNUM (915 g/L)	1.14 to 1.6 kg/ha 1.25 to 1.75 L/ha	 0.5 to 0.7 L/ac	▪ Apply PPI. Incorporate shallowly to maintain spatial separation between herbicide treated zone and developing tomato roots. ▪ Use **ONLY** on transplant tomatoes grown for processing. ▪ **Do NOT** use on muck, peat, high organic matter soils ▪ **Do NOT** use on soils with less than 1% organic matter. ▪ Use the higher rate for heavier weed populations, Eastern black nightshade and yellow nut sedge.
trifluralin TREFLAN EC (480 g/L) RIVAL EC (500 g/L) BONANZA 400 (400 g/L)	0.6 to 1.105 kg/ha 1.25 to 2.3 L/ha 1.2 to 2.2 L/ha 1.5 to 2.75 L/ha	 0.5 to 0.92 L/ac 0.48 to 0.94 L/ac 0.6 to 1.1 L/ac	▪ Apply PPI. Incorporate within 24 hr. of application. Incorporate shallowly to maintain spatial separation between herbicide treated zone and developing transplant roots. ▪ Use **ONLY** on transplant tomatoes grown for processing. ▪ Cool, wet weather may delay transplant establishment but yield is not usually affected. ▪ **Do NOT** apply to peat or muck soils (> 15% organic matter). ▪ **Do NOT** apply to soils with < 2% organic matter. ▪ **Do NOT** apply to fields spread with manure within the last 12 months. ▪ **Do NOT** apply by air.

Tomatoes (Transplanted) — Soil Applied Grass and Broadleaf Herbicides

napropamide DEVRINOL DF (50 DF)	1.12 to 2.25 kg/ha 2.25 to 4.5 kg/ha	 0.9 to 1.8 kg/ac	▪ Apply PPI. Incorporate within 24 hr. of application. Incorporate shallowly to maintain spatial separation between herbicide treated zone and developing transplant roots. ▪ Registered for use on field seeded and transplanted tomatoes. ▪ Use the lower rates on light textured soils. ▪ **Do NOT** apply to soils with over 10% organic matter. ▪ Damage to subsequent cover crops can be reduced by tillage across the rows after harvest. Small grains seeded in the fall may be stunted but not otherwise affected.
pebulate TILLAM (720 g/L)	4.5 to 6.66 kg/ha 6.25 to 9.25 L/ha	 2.8 to 3.7 L/ac	▪ PPI – Apply to a dry soil surface before planting and incorporate. ▪ Apply in 150–300 L water/ha. ▪ Use lower rate on sandy soils. ▪ **Do NOT** use under hotcaps.

Active ingredient TRADE NAME (Formulation)	RATE (active) PRODUCT PER HA	RATE PRODUCT PER ACRE	PRECAUTIONS (For more information see "Notes on Chemicals" section)
s-metolachlor DUAL MAGNUM (915 g/L) plus metribuzin SENCOR 500 F (500 g/L)	1.14 to 1.6 kg/ha 1.25 to 1.75 L/ha 0.25 to 0.7 kg/ha 0.5 to 1.4 L/ha	 0.5 to 0.7 L/ac 0.2 to 0.56 L/ac	▪ Apply PPI. Incorporate shallowly to maintain spatial separation between herbicide treated zone and developing transplant roots. ▪ Use **ONLY** on transplant tomatoes grown for processing. ▪ **Do NOT** use on muck, peat, or high organic matter soils. ▪ **Do NOT** use on soils with < 2% organic matter. ▪ Use the higher rate of DUAL MAGNUM for heavier weed populations, Eastern black nightshade and yellow nut sedge. ▪ Use lower rate of metribuzin and repeat applications of metribuzin when crop is established as described under postemergence application of metribuzin. ▪ **Do NOT** exceed total maximum rate of metribuzin recommended for your soil type.
trifluralin TREFLAN EC (480 g/L) plus s-metolachlor DUAL MAGNUM (915 g/L) plus metribuzin SENCOR 500 F (500 g/L)	0.528 to 1.008 kg/ha 1.1 to 2.1 L/ha 0.96 to 1.260 kg/ha 1.05 to 1.38 L/ha 0.25 to 0.5 kg/ha 0.5 to 1 L/ha	 0.44 to 0.84 L/ac 0.42 to 0.56 L/ac 0.2 to 0.4 L/ac	▪ Apply PPI. Incorporate within 24 hr. of application. Incorporate shallowly to maintain spatial separation between herbicide treated zone and developing transplant roots. ▪ Use **ONLY** on transplant tomatoes grown for processing. ▪ **Do NOT** use on muck, peat or high organic matter soils (> 15% OM). ▪ Use the lower rates on light textured soils. ▪ Use lower rate of metribuzin and repeat applications of metribuzin when crop is established as described under postemergence application of metribuzin. ▪ **Do NOT** exceed total maximum rate of metribuzin recommended for your soil type. ▪ Cool, wet weather may delay establishment, but yield is not usually affected. ▪ For Eastern black nightshade, use the higher rate of DUAL MAGNUM. ▪ Preharvest interval is 60 days.
trifluralin TREFLAN EC (480 g/L) RIVAL EC (500 g/L) BONANZA 400 (400 g/L) plus metribuzin SENCOR 500 F (500 g/L) LEXONE DF (75 DF) EVICT SOLUPAK (75 DF)	0.6 to 1.105 kg/ha 1.25 to 2.3 L/ha 1.2 to 2.2 L/ha 1.5 to 2.75 L/ha 0.25 to 0.7 kg/ha 0.5 to 1.4 L/ha 0.32 to 0.93 kg/ha 0.33 to 0.67 kg/ha	 0.5 to 0.92 L/ac 0.48 to 0.94 L/ac 0.6 to 1.1 L/ac 0.2 to 0.56 L/ac 0.13 to 0.37 kg/ac 0.13 to 0.24 kg/ac	▪ Apply PPI. Incorporate within 24 hr. of application. Incorporate shallowly to maintain spatial separation between herbicide treated zone and developing transplant roots. ▪ Use **ONLY** on transplant tomatoes grown for processing. ▪ **Do NOT** apply to peat or muck soils (> 15% organic matter). ▪ **Do NOT** apply to soils with < 2% organic matter. ▪ **Do NOT** apply to fields spread with manure within the last 12 months. ▪ Use lower rates on sandy soils or soils with low organic matter. ▪ Use lower rate of metribuzin and repeat applications of metribuzin when crop is established as described under postemergence application of metribuzin. ▪ **Do NOT** exceed total maximum rate of metribuzin recommended for your soil type. ▪ Cool, wet weather may delay establishment, but yield is not usually affected.

Tomatoes (Transplanted) — Postemergence Grass Herbicides

POSTEMERGENCE – Leaf stage of the weeds is critical for good weed control. Smaller weeds are generally easier to kill but there needs to be enough leaf surface to intercept the herbicide. Apply according to recommended leaf stages. Crop stage is important to optimize crop safety. Adjuvants will frequently improve the weed control when used as directed. Weather or other conditions may influence the optimum rate of adjuvant, see the product label for more details. Always use appropriate drift management technology.

fenoxaprop-p-ethyl EXCEL SUPER (80.5 g/L)	0.054 kg/ha 0.67 L/ha	 0.27 L/ac	• Apply POST when annual grasses are in the 1–6 leaf stage and volunteer corn is up to 25 cm tall. • Use **ONLY** on transplant tomatoes grown for processing. • Annual grasses emerging after application will not be controlled. • **Do NOT** apply other herbicides within 4 days of EXCEL SUPER application. • **Do NOT** apply by air. • **Do NOT** use flood jet nozzles or controlled droplet application equipment. • Spray tips angled forward 45° will give better coverage. • **Do NOT** apply if rain is expected within 1 hr. after application. • Preharvest interval is 55 days.
fluazifop-p-butyl VENTURE L (125 g/L)	0.075 to 0.25 kg/ha 0.6 to 2 L/ha	 0.24 to 0.8 L/ac	• Apply POST to actively growing grasses before tillering. • Apply at 0.6 L/ha (0.24 L/ac) at 2–5 leaf stage of annual grasses (2–4 leaf for foxtails). • Apply at 0.8 L/ha (0.32 L/ac) at 2–5 leaf stage of volunteer wheat and barley. • Apply at 2 L/ha (0.8 L/ac) at 3–5 leaf stage of quackgrass & wirestem muhly. Thorough preplant tillage, fragmenting quackgrass rhizomes improves control. • Apply in a maximum volume of 300 L/ha (120 L/ac). • **Do NOT** cultivate for 5 days after application. • **Do NOT** apply other herbicides within 3 days of VENTURE L application. • **Do NOT** apply if rain is expected within 2 hr. after application. • Preharvest interval is 60 days.
sethoxydim POAST ULTRA (450 g/L) surfactant/solvent MERGE	0.15 to 0.5 kg/ha 0.32 to 1.1 L/ha 1 to 2 L/ha	 0.13 to 0.45 L/ac 0.4 to 0.8 L/ac	• Apply POST to actively growing grasses. • For annual grass, use 0.32 L/ha. Apply at the 1–6 leaf stage (2–5 is optimum). • For volunteer grains, use 0.47 L/ha. Apply at the 1–6 leaf stage (2–5 is optimum). • For quackgrass, use 1.1 L/ha. Apply up to the 3 leaf stage. Thorough preplant tillage will ensure more uniform quackgrass emergence. Cultivate after 7 days in wide row crops. Use the high rate of MERGE for quackgrass. • Use 100–200 L water/ha (40–80 L water/ac). • Grasses emerging after application will not be controlled. • **Do NOT** apply any other chemicals within 4 days of POAST ULTRA application. • Spray tips angled forward 45° will give better coverage. • **Do NOT** use flood jet or hollow cone nozzles. • **Do NOT** apply if rain is expected within 1 hr. after application. • Preharvest interval is 60 days.

Active Ingredient TRADE NAME (Formulation)	RATE (active) PRODUCT PER HA	RATE PRODUCT PER ACRE	PRECAUTIONS (For more information, see "Notes on Chemicals" section)
[illegible] (Transplanted) — Postemergent Grass and Broadleaf Herbicides			
metribuzin LEXONE DF (75 DF) SENCOR 75 DF (75 WG) EVICT SOLUPAK (75 DF)	0.25 to 0.85 kg/ha 0.32 to 1.1 kg/ha 0.32 to 1.1 kg/ha 0.375 to 0.67 kg/ha	 0.13 to 0.44 kg/ac 0.13 to 0.44 kg/ac 0.15 to 0.44 kg/ha	• Apply POST at least 3 weeks after transplanting before weeds exceed 4 cm in height. • Use **ONLY** on transplant tomatoes grown for processing. • Apply **ONLY** once per season. • Direct spray to bottom one-third of tomato plants to reduce risk of crop injury. • **Do NOT** apply when crop is under stress due to cool, wet, cloudy weather or excessively hot temperatures. • **Do NOT** use on muck soils. • **Do NOT** use on soils with < 2% organic matter. • Use lower rates on sandy soils, higher rates on clay soils. • Preharvest interval is 60 days.
metribuzin SENCOR 500 F (500 g/L) LEXONE DF (75 DF) EVICT SOLUPAK (75 DF)	0.15 kg/ha 0.3 L/ha 0.2 kg/ha 0.2 kg/ha	 0.12 L/ac 0.08 kg/ac 0.08 kg/ac	• Apply one to 4 POST applications per season. • Apply before the weeds are 2.5 cm in height. • Use **ONLY** on transplant tomatoes grown for processing. • BRAVO 500 fungicide (chlorothalanil) may be tank-mixed with this treatment at 2.4 to 4.8 L/ha (1.2 to 2.4 kg/ha active). Control of annual grasses may be reduced. • **Do NOT** apply when crop is under stress due to cool, wet, cloudy weather or excessively hot temperatures. • **Do NOT** use on muck soils. • **Do NOT** use on soils with < 2% organic matter. • **Do NOT** exceed the maximum total rate of metribuzin recommended for your soil. • Preharvest interval is 30 days.
pyridate LENTAGRAN (45 WP) plus metribuzin LEXONE DF (75 DF) SENCOR 75 DF (75 WG)	0.45 to 0.9 kg/ha 1 to 2 kg/ha 0.15 to 0.3 kg/ha 0.2 to 0.4 kg/ha 0.2 to 0.4 kg/ha	 0.4 to 0.8 kg/ac 0.08 to 0.16 kg/ac 0.08 to 0.16 kg/ac	• Apply POST as a directed spray to the bottom 1/3rd of well-established plants. • **Do NOT** apply before tomato plants reach the 5–leaf stage. • **Do NOT** apply if tomato plants are under stress. • **Do NOT** apply as a POST broadcast application due to crop injury. • Sprayed leaves may discolour temporarily, but yield will not be affected. • **Do NOT** apply more than once per season. • **Do NOT** use on muck soils. • **Do NOT** use on soils with < 2% organic matter. • Preharvest interval is 45 days.
rimsulfuron PRISM (25DF) plus non-ionic surfactant CITOWETT PLUS, AGRAL 90 or AG-SURF	15 g/ha 60 g/ha 0.2% v/v 2L/1000 L water	 24 g/ac 0.2% v/v 2L/1000 L water	• Apply POST when hairy nightshade is up to the 4 leaf stage, quackgrass is in the 3–6 leaf stage (less than 10 cm tall), annual grasses are in the 1–6 leaf stage and redroot pigweed is at the 4–6 leaf stage. • Apply **ONLY** once per year. • **Do NOT** apply if rainfall is expected within 2 hr. of application. • Preharvest interval is 30 days.

Notes:

Weed control ratings are given as 0-9 where 0 indicates no control and 9 indicates 90%-100% control under ideal conditions.
Ratings are subjective values based on best available information and give general comparisons based on use as descibed in this guide.
Under unfavorable conditions (eg., too dry, too wet, too cold, or poor application) the herbicides may not be as effective as indicated.
Ratings may vary with weed and crop stage and with the timing and rates of the product(s) being used.
Ratings in **BOLD** indicate the weed is listed on the product label for control or suppression.
Please see product label for more information on registered weed species, product uses and precautions.

TABLE 21. Vegetable Herbicide Weed Control Ratings

	Grasses					Annual Broadleaves								Perennials						
Trade Name	barnyard grass	crabgrass	fall panicum	foxtails	old witch grass	buckwheat, wild	lady's thumb	lamb's-quarters	mustards	nightshades	pigweeds	ragweed	velvetleaf	bindweed, field	horsetail	milkweed	nutsedge	quackgrass	sow-thistle	thistle, Canada
RO-NEET	**8**	**8**	6	**8**	8	?	?	**7**	5	**7**	**8**	?	?	?	?	?	**6**	?	?	?
EPTAM	**9**	**9**	**9**	**9**	**9**	4	7	**7**	5	7	**7**	5	5	?	?	?	**8**	**5**	?	?
DEVRINOL	**8**	**9**	**8**	8	8	5	6	**8**	5	5	**8**	**7**	5	5	5	5	6	5	5	5
PROWL	**9**	**8**	9	**8**	?	?	6	**9**	?	8	**8**	2	6	?	?	?	?	?	?	?
DUAL MAGNUM	**9**	**9**	**9**	**9**	**9**	2	2	7	2	**8**	**7/8**	4	2	0	0	0	**8**	4	0	0
AVADEX	5	?	?	5	5	5	5	5	5	?	5	5	?	5	?	?	?	?	5	5
LOROX, AFOLAN or LINURON 480	**7**	**5**	**5**	**7**	**7**	**8**	**9**	**9**	**9**	8	**9**	**8**	**6**	2	2	2	2	2	2	2
PATORAN	**5**	**5**	5	**5**	**5**	8	**9**	**9**	**9**	**7**	**9**	**8**	6	2	2	2	2	2	2	2
SENCOR, LEXONE or EVICT	**7**	**6**	**7**	**8**	**8**	7	**9**	**9**	**9**	3	**9**	**8**	**8**	2	2	2	2	2	2	2
AFESIN	**5**	**5**	5	**5**	5	**8**	9	**9**	9	**7**	**9**	**8**	6	2	2	2	2	2	2	2
GESAGARD	?	?	?	**9**	?	?	**8**	**9**	**8**	**8**	**8**	6	?	?	?	?	?	?	?	?
PYRAMIN	**5**	**5**	5	**5**	5	**8**	**8**	**8**	8	**8**	**8**	**8**	6	5	5	?	5	5	5	5
KARMEX	9	**8**	7	**8**	?	8	8	**9**	8	7	**8**	**9**	?	?	5	?	5	5	5	5
SINBAR	**8**	**7**	8	**8**	8	?	7	**8**	**8**	7	**7**	**7**	7	?	5	6	6	6	?	6
CIPC	8	9	7	8	7	8	8	7	5	?	7	5	?	?	5	?	?	5	5	5
NORTRON SC	**7**	**6**	7	**7**	7	**8**	**8**	**8**	8	**7**	**8**	8	7	5	5	5	6	5	5	5
PURSUIT	**8**	7	7	**9**	9	8	**9**	**9**	**9**	**9**	**9**	**8**	**9**	?	?	?	7	5	?	?
ALANAP	5	7	5	7	?	5	9	9	6	5	8	5	?	?	5	?	5	5	5	5
KERB	**8**	**8**	**8**	**8**	**8**	?	6	6	7	7	0	0	0	0	0	0	0	0	0	0
PRINCEP NINE-T	**9**	**8**	7	**9**	**9**	**9**	**9**	**9**	9	9	9	**8**	5	2	0	0	5	5	2	2
TILLAM	**9**	**8**	5	**9**	5	?	2	2	2	2	5	2	2	0	5	0	**8**	0	0	0
TREFLAN or RIVAL or BONANZA 400	9	9	9	**9**	9	**5**	7	**8**	2	2	**8**	4	2	2	2	2	2	2	2	2
KERB	**8**	**8**	6	**8**	?	?	0	0	0	?	6	0	0	0	0	0	0	**8**	0	0
SELECT	**9**	**8**	**9**	**8**	**9**	0	0	0	0	0	0	0	0	0	0	0	0	**7**	0	0

TABLE 21 Vegetable Herbicide Weed Control Ratings

Trade Name	Grasses					Annual Broadleaves								Perennials						
	barnyard grass	crabgrass	fall panicum	foxtails	old witch grass	buckwheat, wild	lady's thumb	lamb's-quarters	mustards	nightshades	pigweeds	ragweed	velvetleaf	bindweed, field	horsetail	milkweed	nutsedge	quackgrass	sow-thistle	thistle, Canada
HOE-GRASS 284	8	5	8	8	8	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0
EXCEL SUPER	9	8	9	9	9	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0
VENTURE L	8	8	9	8	9	0	0	0	0	0	0	0	0	0	0	0	0	8	0	0
POAST ULTRA	9	8	9	9	9	0	0	0	0	0	0	0	0	0	0	0	0	6	0	0
2,4-D*	0	0	0	0	0	7	7	9	9	7	9	9	9	7	0	0	0	0	8	8
BASAGRAN FORTE	0	0	0	0	0	7	9	8	9	7	8	8	9	6[a]	2	2	8[a]	0	6[a]	7[a]
PARDNER	0	0	0	0	0	9	9	9	8	9	8	9	9	7	0	0	0	0	7	7
LONTREL	5	5	5	5	5	?	7	5	?	5	5	8	5	5	?	?	5	5	7	7
BETANEX	5	5	5	5	5	5	6	7	7	6	9	9	5	5	?	?	5	5	5	5
BETAMIX	5	5	5	7	5	6	6	8	7	6	8	8	5	5	?	?	5	5	5	5
herbicidal oil*	?	?	?	?	?	?	6	7	7	?	7	5	?	5	5	5	5	5	5	5
MCPA*	0	0	0	0	0	4	0	9	9	?	9	8	9	7	7	0	0	0	7	7
GOAL 2XL	5	5	5	5	5	9	8	8	9	9	9	8	7	5	5	5	5	5	5	5
PYRAMIN	5	5	?	5	?	8	8	8	8	8	8	8	?	?	5	?	5	5	5	5
LENTAGRAN	?	?	?	?	?	?	?	8	?	?	8	?	?	?	?	?	?	?	?	?
LOROX, AFOLAN or LINURON 480	?	7	9	8	9	8	8	8	8	8	8	8	8	7	8	7	8	7	8	7
SENCOR or LEXONE or EVICT	8	7	9	8	9	7	9	8	9	?	8	8	8	?	?	?	?	7	?	?
SPIN-AID	5	5	5	6	5	?	8	8	?	7	6	8	7	5	5	5	5	5	5	5
PRISM	9	8	9	8[b]	9	?	7	7	9	4[c]	9	3	6	?	?	?	?	7	?	?
LENTAGRAN + SENCOR or LEXONE	6	5	?	6	?	7	7	9	8	9	9	9	8	5	5	5	5	5	5	5
IGNITE	9	9	9	9	9	?	9	9	9	?	9	9	9	8[d]	7[d]	6[d]	0	8[d]	?	?

* Various formulations available, see Table 1.

? Insufficient information available to make a rating.

[a] Good control of these perennial weeds may require two applications of BASAGRAN + ASSIST oil concentrate about 7 to 10 days apart

[b] Yellow foxtail will only be suppressed.

[c] Registered for control of hairy nightshade

[d] Repeated applications may be necessary if regrowth occurs.

CHAPTER 14. BERRY CROPS

Cultural Weed Control in Berry Crops

A successful weed control program must integrate cultural and chemical weed control practices. Growers cannot depend entirely on chemical weed control in berry crops, since there is a limited spectrum of herbicides registered for these crops.

PERENNIAL WEED CONTROL

It is important to identify and control perennial weeds in the preplanting year. It is very difficult to control perennial weeds once a planting is established because of crop sensitivity to some herbicides and since it is not possible to clean cultivate in established berry crops.

The following perennial weeds present serious problems in these crops; quackgrass, bindweed, vetch, wild grape, perennial nightshade, thistles, ground-ivy (creeping Charlie) and burdock. In strawberries, sheep sorrel, toa DFlax and milkweed also present problems.

Systemic herbicides such as glyphosate (eg. ROUNDUP) or amitrole (eg. AMITROL 240) should be applied to perennial weeds in the preplanting year. Consult the product label and be sure to use the recommended rate for the weed in question. Apply the herbicide at the proper stage of growth of the weed, otherwise only temporary control will be achieved. Repeated cultivations of some perennial weeds such as bindweed will also provide control.

SITE PREPARATION

A green manure crop such as perennial ryegrass or Sudan grass should be established in the preplanting year following or in conjunction with measures to control perennial weeds. This crop will provide competition to reduce weed growth as well as improving the soil structure. Non-selective herbicides can be applied before planting the green manure crop and before plowing it under. Short residual selective herbicides such as 2,4-D may be used with the green manure crop, but avoid using herbicides that leave a soil residue that will carry over into the planting year.

MULCHING

For bramble and bush fruit, a biodegradable plastic mulch could be used for weed control in the planting strip. Straw mulch will also assist in weed control beneath the plants or in the planting strip if it is applied early in the season before the weed seeds germinate. Use mulch that is free of weed seeds and ensure that enough nitrogen is provided for the plants. The mulch should be pulled away from around the plants for winter rodent protection.

For strawberries, use of straw mulch before weeds germinate can help control weeds. Some growers are trying plasticulture as a way to improve weed control.

REDUCING WEED PRESSURE

Cultivation can provide weed control between the rows. In bramble and bush fruit, a vigorous sod between the rows will prevent weeds from becoming established. It is better to seed in a fescue sod than to rely on a natural sod composed of weed and grass species, since the weeds will seed into the herbicide strip.

Prevent weeds from setting seed in adjacent uncropped areas by using cultural or chemical weed control measures. Mowing at regular intervals will prevent many weeds from flowering. Try to control weeds which escape before they set seed, by cultural removal or chemical mowing. In some situations, tools such as a weed whip may be of use. Mowers are available which will cut close to the plants without injury. Mowing, however, will not eliminate weed competition.

ROTATING HERBICIDE FAMILIES (see Table 3, HERBICIDE GROUPINGS FOR ONTARIO)

In perennial crops, rotation of herbicide families is important to minimize the building up of seed from weed escapes, including triazine tolerant weeds. Rotation will also help avoid an accumulation of herbicide residues in the soil that may result in crop injury over a period of years and may hinder replanting.

TRADE NAME	RATE PRODUCT PER ha	RATE PRODUCT PER ACRE	PRECAUTIONS For more information, see Chapter 4, Notes on Herbicides and Chapter 5, Notes on Adjuvants

Blueberries, Highbush

CULTURAL WEED CONTROL — see previous page.

Mulching: A biodegradable mulch could be used for weed control within the plant row. Sawdust mulch will assist in weed control if it is applied early in the season before the weed seeds germinate. Apply old sawdust 5 cm thick. The mulch will not prevent the germination of weed seeds that may blow onto the surface of the mulch.

In subsequent years, the organic matter in the mulch may tie up and thus reduce the effectiveness of certain residual herbicides.

The nitrogen requirements of the crop will change as the mulch is degraded. Initially, nitrogen will be consumed by microorganisms, thus necessitating higher rates of nitrogen fertilizer. Later, as the sawdust is degrading, nitrogen will be released and the crop may require less nitrogen fertilizer than an unmulched crop. It may take 2 years or more for sawdust mulch to significantly decompose. Adjust fertilizer rates according to mulch breakdown, plant growth and leaf nutrient analysis results.

[illegible] — See Chapter 6, Special Methods of Weed Control

Recommended rates /ha or /ac refer to area actually treated with herbicide.

PREEMERGENCE (PRE) — Rainfall at 15–20 mm within 7–10 days after application is necessary to activate preemergence treatments. Shallow cultivation, or harrowing will control weed escapes and improve herbicide activity in the absence of rainfall.

CAUTION — Simazine, DEVRINOL and SINBAR residues, high enough to harm many crops, may persist for several years after removal of the planting.

[illegible] — Year of Planting (Soil Applied Grass & Broadleaf Herbicides)

napropamide DEVRINOL DF (50 DF)	4.5 kg/ha 9 L/ha	 3.6 L/ac	• PRE — Apply once per season, either in the fall or spring, before weeds emerge. • Incorporation by rainfall or irrigation is essential. • **Do NOT** apply to frozen ground.

[illegible] — Year of Planting (Postemergence Grass Herbicides)

POSTEMERGENCE – Leaf stage of the weeds is critical for good weed control. Smaller weeds are generally easier to kill but there needs to be enough leaf surface to intercept the herbicide. Apply according to recommended leaf stages. Crop stage is important to optimize crop safety. Adjuvants will frequently improve the weed control when used as directed. Weather or other conditions may influence the optimum rate of adjuvant, see the product label for more details. Always use appropriate drift management technology.

fluazifop-p-butyl VENTURE L (125 g/L)	0.125 to 0.25 kg/ha 1 L to 2 L /ha	 0.48 to 0.8 L/ac	• Apply to actively growing grasses. • For annual grasses, use 1 L/ha. Apply at the 2–6 leaf stage. • For quackgrass, use 2 L/ha. Apply at the 3–5 leaf stage. Thorough preplant tillage will ensure more uniform quackgrass emergence. Cultivate after 7 days. • **Do NOT** apply closer than 30 days to harvest.

sethoxydim	0.15 to 0.5 kg/ha		• Apply to actively growing grasses.
POAST ULTRA (450 g/L) plus surfactant/solvent	0.32 to 1.1 L/ha	0.13 to 0.45 L/ac	• For annual grass, use 0.32 L/ha. Apply at the 1–6 leaf stage (2–5 is optimum). • For volunteer grains, use 0.47 L/ha. Apply at the 1–6 leaf stage (2–5 is optimum).
MERGE	1 to 2 L/ha	0.4 to 0.8 L/ac	• For quackgrass, use 1.1 L/ha. Apply up to the 3–leaf stage. Thorough preplant tillage will ensure more uniform quackgrass emergence. Cultivate after 7 days. Use the high rate of MERGE for quackgrass. • Use 100□200 L water/ha (40–80 L water/ac). • Grasses emerging after application will not be controlled. • Spray tips angled forward 45° will give better coverage. • **Do NOT** use flood jet or hollow cone nozzles. • **Do NOT** apply if rain is expected within 1 hr. after application. • **Do NOT** apply closer than 15 days to harvest.
Blueberries (Highbush) — Year of Planting (Postemergence Broadleaf Herbicides)			
clopyralid	0.15 to 0.3 kg/ha		• Apply once per year, directed under the bushes on emerged weeds.
LONTREL 360 (360 g/L)	0.42 to 0.83 L/ha	0.17 to 0.33 L/ac	• For emerged vetch, use 0.42 L/ha • For red and white clover, use 0.83 L/ha. • **Do NOT** apply closer than 45 days to harvest.
Blueberries (Highbush) — Year of Planting (Postemergence Grass & Broadleaf Herbicides)			
glyphosate	1 to 2 kg/ha		• Apply as a directed spray under the bushes, avoiding new shoots.
glyphosate* (360 g/L)	2.8 to 5.6 L/ha	1.12 to 2.24 L/ac	• Apply in 200–300 L/ha water (80–120 L/ac), using no more than 275 kPa pressure. • Avoid contact with fruit, foliage or canes. • Use only 1 application per season. • **Do NOT** apply closer than 30 days to harvest.
Blueberries (Highbush) — Established Plantings (Soil Applied Grass & Broadleaf Herbicides)			
dichlobenil	7 to 9 kg/ha		• PRE — Apply to cool moist but unfrozen soil in late fall or spring before weeds emerge.
CASORON 4G (4 Gr)	175 to 225 kg/ha	70 to 90 kg/ac	• **Do NOT** apply if air temps are above 10–15°C to avoid injury from volatilization. • Use the lower rate if irrigation or rain will follow application. • 70 g CASORON 4G applied to an area 2x2 m is equivalent to 175 kg/ha (70 kg/ac). • Use **ONLY** under plants established for at least 3 yrs. • **Do NOT** use on light, sandy soil.
napropamide	4.5 kg/ha		• PRE — Apply once per season, either in the fall or spring, before weeds emerge.
DEVRINOL DF (50 DF)	9 kg/ha	3.6 kg/ac	• Incorporation by rainfall or irrigation is essential. • **Do NOT** apply to frozen ground. • **Do NOT** apply within 70 days of harvest.
simazine	2.25 to 3.38 kg/ha		• PRE — Apply in 300–1000 L/ha water (120–400 L/ac) before weed emergence.
PRINCEP NINE-T (90 WG)	2.5 to 3.75 kg/ha	1 to 1.5 kg/ac	• Use lower rates for coarse, sandy soil.
SIMAZINE 80W (80 WP)	2.75 to 4.25 kg/ha	1.1 to 1.7 kg/ac	• Use higher rates for clay or higher organic matter soil. • Use only on established plants.

[illegible] TRADE NAME Formulation	RATE active ingredient PRODUCT PER HA	RATE PRODUCT PER ACRE	PRECAUTIONS For more information see Chapter 4 Notes on Herbicides and Chapter 5 Notes on Alfalfa
terbacil SINBAR (80 WP)	2.2 to 3.4 kg/ha 2.75 to 4.25 kg/ha	 1.1 to 1.7 kg/ac	• PRE — Apply in 200–1000 L/ha water (80–400 L/ac). • Use only in plantings established in the field for at least 1 year. • Make 1 application per year. • Injury may occur on sandy soil even with the low rate. • Use the high rate only on muck or peat soils where experience has shown this to be a safe practice.
[illegible] (Alfalfa) — Established Plantings (Postemergence Grass Herbicides)			
POSTEMERGENCE — Leaf stage of the weeds is critical for good weed control. Smaller weeds are generally easier to kill but there needs to be enough leaf surface to intercept the herbicide. Apply according to recommended leaf stages. Crop stage is important to optimize crop safety. Adjuvants will frequently improve the weed control when used as directed. Weather or other conditions may influence the optimum rate of adjuvant, see the product label for more details. Always use appropriate drift management technology.			
fluazifop-p-butyl VENTURE L (125 g/L)	0.125 to 0.25 kg/ha 1 L to 2 L /ha	 0.48 to 0.8 L/ac	• Apply to actively growing grasses. • For annual grasses, use 1 L/ha. Apply at the 2–6 leaf stage. • For quackgrass, use 2 L/ha. Apply at the 3–5 leaf stage. Thorough preplant tillage will ensure more uniform quackgrass emergence. Cultivate after 7 days. • **Do NOT** apply closer than 30 days to harvest.
sethoxydim POAST ULTRA (450 g/L) plus surfactant/solvent MERGE	0.15 to 0.5 kg/ha 0.32 to 1.1 L/ha 1 to 2 L/ha	 0.13 to 0.45 L/ac 0.4 to 0.8 L/ac	• Apply to actively growing grasses. • For annual grass, use 0.32 L/ha. Apply at the 1–6 leaf stage (2–5 is optimum). • For volunteer grains, use 0.47 L/ha. Apply at the 1–6 leaf stage (2–5 is optimum). • For quackgrass, use 1.1 L/ha. Apply up to the 3–leaf stage. Thorough preplant tillage will ensure more uniform quackgrass emergence. Cultivate after 7 days. Use the high rate of MERGE for quackgrass. • Use 100–200 L water/ha (40–80 L water/ac). • Grasses emerging after application will not be controlled. • Spray tips angled forward 45° will give better coverage. • **Do NOT** use flood jet or hollow cone nozzles. • **Do NOT** apply if rain is expected within 1 hr. after application. • **Do NOT** apply closer than 15 days to harvest.
[illegible] (Alfalfa) — Established Plantings (Postemergence Broadleaf Herbicides)			
bentazon BASAGRAN plus oil concentrate ASSIST	0.84 kg/ha 1.75 L/ha	 0.7 L/ac	• For top growth control of yellow nut sedge. • Make 2 applications 7–10 days apart, when weeds are small. • **Do NOT** apply more than 2 times per year. • **Do NOT** apply closer than 25 days to harvest.
clopyralid LONTREL 360 (360 g/L)	0.15 to 0.3 kg/ha 0.42 to 0.83 L/ha	 0.17 to 0.33 L/ac	• Apply once per year, directed under the bushes on emerged weeds. • For emerged vetch, use 0.42 L/ha. • For red and white clover, use 0.83 L/ha. • Do NOT apply closer than 45 days to harvest.

Blueberries (Highbush) — Established Plantings (Postemergence Grass & Broadleaf Herbicides)			
glyphosate glyphosate* (360 g/L)	1 to 2 kg/ha 2.8 to 5.6 L/ha	 1.12 to 2.24 L/ac	▪ Apply as a directed spray under the bushes, avoiding new shoots. ▪ Apply in 200–300 L/ha water (80–120 L/ac), using no more than 275 kPa pressure. ▪ Avoid contact with fruit, foliage or canes. ▪ Use only 1 application per season. ▪ **Do NOT** apply closer than 30 days to harvest.
paraquat GRAMOXONE (200 g/L)	1.1 kg/ha 5.5 L/ha	 2.2 L/ac	▪ Apply in 1000 L/ha water (400 L/ac). ▪ For spot spraying, apply 55 mL product/10 L water sprayed to wet weed foliage. ▪ Use on plantings established at least 1 year.
paraquat GRAMOXONE (200 g/L) plus simazine PRINCEP NINE-T (90WG)	1.1 kg/ha 5.5 L/ha 2.25 to 3.38 kg/ha 2.5 to 3.75 kg/ha	 2.2 L/ac 1 to 1.5 kg/ac	▪ For emerged weeds with residual control of germinating weeds. ▪ Apply as a directed spray to established plantings. ▪ Use 1000 L/ha water (400 L/ac) to wet weed foliage. ▪ Use lower rates for coarse, sandy soil. ▪ Use higher rates for clay or higher organic matter soil.

* Various formulations available, see Table 1. See label for specific uses and rates.

Cranberries

Maintaining a healthy and vigorous crop will aid in weed control by avoiding openings in the bed for weed germination and establishment.

Prevent weeds from setting seed on dikes and in adjacent uncropped areas by using cultural or chemical weed control measures. Mowing at regular intervals will prevent many weeds from setting seed. Seeding the dikes with a desirable grass cover will reduce the opportunities for weed establishment and will provide bank stabilization.

Site Preparation Before Planting — See Chapter 6, Special Methods of Weed Control

PREEMERGENCE — Rainfall at 1520 mm within 710 days after application is necessary to activate preemergence treatments. Shallow cultivation, or harrowing will control weed escapes and improve herbicide activity in the absence of rainfall.

Cranberries — Soil Applied Grass and Broadleaf Herbicides			
dichlobenil CASORON 4G (4 Gr)	4.4 kg/ha 110 kg/ha	 44 kg/ac	▪ PRE – For annual broadleaf weeds, certain sedges and *Juncus* species. ▪ Apply in early spring prebloom. ▪ Temporary reddening of plants may occur, especially with late spring applications. ▪ **Do NOT** use on new plantings, or on newly sanded beds. ▪ **Do NOT** use on beds recently mowed for vines.
napropamide DEVRINOL 10G (10%)	4.5 to 6.7 kg/ha 45 to 67 kg/ha	 18 to 26.8 kg/ac	▪ PRE – Apply once per year in spring and irrigate immediately. ▪ **Do NOT** use on new beds.

Cranberries — Postemergence Grass Herbicides

POSTEMERGENCE — Leaf stage of the weeds is critical for good weed control. Smaller weeds are generally easier to kill but there needs to be enough leaf surface to intercept the herbicide. Apply according to recommended leaf stages. Crop stage is important to optimize crop safety. Adjuvants will frequently improve the weed control when used as directed. Weather or other conditions may influence the optimum rate of adjuvant, see the product label for more details. Always use appropriate drift management technology.

fluazifop-p-butyl VENTURE L (125 g/L)	0.125 to 0.25 kg/ha 1 to 2 L/ha	 0.4 to 0.8 L/ac	▪ For non-bearing cranberries. ▪ Apply to actively growing grasses. ▪ For annual grasses, use 1.0 L/ha. Apply at the 2–6 leaf stage. ▪ For quackgrass, use 2 L/ha. Apply at the 3–5 leaf stage. Thorough preplant tillage will ensure more uniform quackgrass emergence. ▪ Use **ONLY** one application per season.

active ingredient TRADE NAME, Formulation	RATE active ingredient PRODUCT PER HA	RATE PRODUCT PER ACRE	PRECAUTIONS For more information, see Chapter 4, Notes on Herbicides and Chapter 5, Notes on Adjuvants
sethoxydim POAST ULTRA (450 g/L) plus surfactant/solvent MERGE	0.15 to 0.5 kg/ha 0.32 to 1.1 L/ha 1 to 2 L/ha	 0.13 to 0.45 L/ac 0.4 to 0.8 L/ac	• Apply to actively growing grasses. • For annual grass, use 0.32 L/ha. Apply at the 1–6 leaf stage (2–5 is optimum). • For volunteer grains, use 0.47 L/ha. Apply at the 1–6 leaf stage (2–5 is optimum). • For quackgrass, use 1.1 L/ha. Apply up to the 3–leaf stage. Thorough preplant tillage will ensure more uniform quackgrass emergence. Use the high rate of MERGE for quackgrass. • Use 100–200 L water/ha (40–80 L water/ac). • Grasses emerging after application will not be controlled. • Spray tips angled forward 45° will give better coverage. • **Do NOT** use flood jet or hollow cone nozzles. • **Do NOT** apply if rain is expected within 1 hr. after application. • **Do NOT** apply closer than 15 days to harvest.
Cranberries — Postemergence Broadleaf Herbicides			
2,4-D 2,4-D AMINE 500 (470 g/L)	0.47 kg/2L water 1 L/2 L water (33% solution)		• For emerged annual and perennial weeds, including hardhack, St. John's Wort, alder, purple aster. • Apply with a ropewick or other wiper to actively growing weeds (June to July). • **Do NOT** contact the crop. • Use **ONLY** one application per year. • **Do NOT** apply closer than 50 days to harvest.
clopyralid LONTREL 360 (360 g/L)	7.2 g/L water 20 mL/L water (2% solution)		• For emerged vetch. • **Do NOT** use more than 2 applications a year — in spring before bud break, again until growth is 1 to 2 mm long, and/or in the fall at least 2 weeks after harvest, when vines have winter dormancy colour. • Apply with wiper equipment onto weed foliage that extends above the cranberry canopy. Avoid contact with cranberry shoots after growth begins. • **Do NOT** apply closer than 60 days to harvest.
Cranberries — Postemergence Grass and Broadleaf Herbicides			
glyphosate* glyphosate (360 g/L)	0.36 kg/4L of water 1 L/4L of water (20% solution)		• Apply with a rope wick or other similar device when weeds are 15 cm above the crop. • Avoid contact with the cranberry vines. • **Do NOT** apply when weeds are wet. • See **Chapter 2, Selective Weed Control with Wiper Applicators.**

* Various formulations available, see Table 1. See label for specific uses and rates.

Currants and Gooseberries

Cultural Weed Control — See notes on **CULTURAL WEED CONTROL IN FRUIT AND ORNAMENTAL CROPS** section. There are no herbicides registered for preemergence weed control in currants and gooseberries. A biodegradable mulch could be used for weed control in the planting strip. A straw mulch will assist in weed control.

Site Preparation Before Planting — See Chapter 6, Special Methods of Weed Control

Recommended rates /ha or /ac refer to area actually treated with herbicide. POSTEMERGENCE – Leaf stage of the weeds is critical for good weed control. Smaller weeds are generally easier to kill but there needs to be enough leaf surface to intercept the herbicide. Apply according to recommended leaf stages. Crop stage is important to optimize crop safety. Always use appropriate drift management technology.

Currants and Gooseberries — Established Plantings (Postemergence Grass & Broadleaf Herbicides)

paraquat GRAMOXONE (200 g/L)	1.1 kg/ha 5.5 L/ha	 2.2 L/ac	• Apply in 1000 L/ha water (400 L/ac). • For spot treatment, apply 55 mL in 10 L of water, sprayed to wet weed foliage. • Direct the spray to wet the weeds but avoid wetting the leaves or green bark of the bushes.

Raspberries

Cultural Weed Control — See notes on **CULTURAL WEED CONTROL IN FRUIT AND ORNAMENTAL CROPS** section.

Site Preperation Before Planting — See Chapter 6, Special Methods of Weed Control

Recommended rates /ha or /ac refer to area actually treated with herbicide.

PREEMERGENCE – Rainfall at 15–20 mm within 7–10 days after application is necessary to activate preemergence treatments. Shallow cultivation, or harrowing will control weed escapes and improve herbicide activity in the absence of rainfall.

CAUTION: DEVRINOL and SIMAZINE residues, high enough to harm many crops, may persist for several years after removal of a planting.

Raspberries — Year of Planting (Soil Applied Grass & Broadleaf Herbicides)

napropamide DEVRINOL DF (50 DF)	4.5 kg/ha 9 L/ha	 3.6 L/ac	• PRE – Apply once per season, either in the fall or spring, before weeds emerge. • Incorporation by rainfall or irrigation is essential. • **Do NOT** apply to frozen ground. • Avoid contact with fruit or foliage.

Raspberries — Year of Planting (Postemergence Grass Herbicides)

POSTEMERGENCE — Leaf stage of the weeds is critical for good weed control. Smaller weeds are generally easier to kill but there needs to be enough leaf surface to intercept the herbicide. Apply according to recommended leaf stages. Crop stage is important to optimize crop safety. Always use appropriate drift management technology.

fluazifop-p-butyl VENTURE L (125 g/L)	0.15 to 0.25 kg/ha 1.2 to 2 L/ha	 0.48 to 0.8 L/ac	• Apply in early spring at prebloom stage to actively growing grasses. • For annual grasses, use 1.2 L/ha. Apply at the 2–6 leaf stage. • For quackgrass, use 2 L/ha. Apply at the 3–5 leaf stage. Thorough preplant tillage will ensure more uniform quackgrass emergence. Cultivate after 7 days. • **Do NOT** apply closer than 30 days to harvest.

Raspberries — Year of Planting (Postemergence Broadleaf Herbicides)

2,4-D * 2,4-D (470 g/L)	0.55 kg/ha 1.2 L/ha	 0.48 L/ac	• Use the amine formulation. • Apply in 100–200 L/ha water (40–80 L/ac). • **Do NOT** spray when plants are in bloom. • Keep spray off new shoots as much as possible. • Spot spraying at a rate equivalent to 1 kg ai/ha (0.4 kg ai/ac) may be necessary to control established dandelions and other broadleaf weeds.

Raspberries — Year of Planting (Postemergence Grass & Broadleaf Herbicides)

paraquat GRAMOXONE (200 g/L)	1.1 kg/ha 5.5 L/ha	 2.2 L/ac	• Apply in 1000 L/ha water (400 L/ac). • For spot spraying, apply 55mL GRAMOXONE/10 L water sprayed to wet weed foliage. • Direct spray at base of canes in the spring before new shoots emerge.

TRADE NAME, Formulation	RATE active PRODUCT PER HA	RATE PRODUCT PER ACRE	PRECAUTIONS For more information see Chapter 4 Notes on Herbicides and Chapter 5 Notes on Adjuvants
Raspberries — Established Plantings (Soil Applied Grass & Broadleaf Herbicides)			
dichlobenil CASORON 4G (4 Gr)	7 kg/ha 175 kg/ha	 70 kg/ac	• PRE — Apply on established raspberry plantings in late fall. • Apply to cool moist but unfrozen soil before weeds emerge. • **Do NOT** apply if air temps are above 10–15°C to avoid injury from volatilization. • 70 g CASORON 4G applied to an area 2x2 m is equivalent to 175 kg/ha (70 kg/ac). • **Do NOT** use on light, sandy soil. • **Do NOT** cultivate or work into the soil. • **Do NOT apply in the spring** as injury may result.
napropamide DEVRINOL DF (50 DF)	4.5 kg/ha 9 kg/ha	 3.6 kg/ac	• PRE — Apply once per season, either in the fall or spring, before weeds emerge. • Incorporation by rainfall or irrigation is essential. • **Do NOT** apply to frozen ground. • Avoid contact with fruit or foliage.
simazine PRINCEP NINE-T (90WG) SIMADEX (500 g/L) SIMAZINE 480 (480 g/L)	1.8 to 2.25 kg/ha 2 to 2.5 kg/ha 3.6 to 4.5 L/ha 3.8 to 4.7 L/ha	 0.8 to 1 kg/ac 1.44 to 1.8 L/ac 1.52 to 1.88 L/ac	• PRE — Apply in 300–1000 L/ha water (120–400 L/ac) before weed emergence. • Apply as a directed spray early in the spring before the weeds emerge. • Use lower rates for coarse, sandy soil. • Use higher rates for clay or higher organic matter soil. • Keep spray off young shoots. • **Do NOT** use in first year plantings.
Raspberries — Established Plantings (Postemergence Grass Herbicides)			
POSTEMERGENCE — Leaf stage of the weeds is critical for good weed control. Smaller weeds are generally easier to kill but there needs to be enough leaf surface to intercept the herbicide. Apply according to recommended leaf stages. Crop stage is important to optimize crop safety. Adjuvants will frequently improve the weed control when used as directed. Weather or other conditions may influence the optimum rate of adjuvant, see the product label for more details. Always use appropriate drift management technology.			
fluazifop-p-butyl VENTURE L (125 g/L)	0.15 to 0.25 kg/ha 1.2 to 2 L/ha	 0.48 to 0.8 L/ac	• Apply in early spring at prebloom stage to actively growing grasses. • For annual grasses, use 1.2 L/ha. Apply at the 2–6 leaf stage. • For quackgrass, use 2 L/ha. Apply at the 3–5 leaf stage. Thorough preplant tillage will ensure more uniform quackgrass emergence. Cultivate after 7 days. • **Do NOT** apply closer than 30 days to harvest.
sethoxydim POAST ULTRA (450 g/L) plus surfactant/solvent MERGE	0.15 to 0.5 kg/ha 0.32 to 1.1 L/ha 1 to 2 L/ha	 0.13 to 0.45 L/ac 0.4 to 0.8 L/ac	• Apply to actively growing grasses. • For annual grass, use 0.32 L/ha. Apply at the 1–6 leaf stage (2–5 is optimum). • For volunteer grains, use 0.47 L/ha. Apply at the 1–6 leaf stage (2–5 is optimum). • For quackgrass, use 1.1 L/ha. Apply up to the 3–leaf stage. Thorough preplant tillage will ensure more uniform quackgrass emergence. Cultivate after 7 days. Use the high rate of MERGE for quackgrass. • Use 100–200 L water/ha (40–80 L water/ac). • Grasses emerging after application will not be controlled. • Spray tips angled forward 45° will give better coverage. • **Do NOT** use flood jet or hollow cone nozzles. • **Do NOT** apply if rain is expected within 1 hr. after application. • **Do NOT** apply closer than 37 days to harvest.

Raspberries — Established Plantings (Postemergence Broadleaf Herbicides)

2,4-D *	0.55 kg/ha		• Use the amine formulation.
2,4-D (470 g/L)	1.2 L/ha	0.48 L/ac	• Apply in 100–200 L/ha water (40–80 L/ac) actually sprayed. • **Do NOT** spray when plants are in bloom. • Keep spray off new shoots as much as possible. • Spot spraying at a rate equivalent to 1 kg ai/ha (0.4 kg ai/ac) may be necessary to control established dandelions and other broadleaf weeds.

Raspberries — Established Plantings (Postemergence Grass & Broadleaf Herbicides)

glufosinate ammonium	1 kg/ha		• For use in the production year of raspberries grown in the biennial production system, or in a planting that will be removed after harvest. • **Do NOT** apply to immature and weak plantings. • Apply when shoots are 10–20 cm tall to suppress the emerged flush of primocanes, and control any weeds emerged at time of treatment. • Apply in a minimum of 330 L water/ha (132 L/ac). • Avoid drift onto green tissue of floricanes.
IGNITE (150 g/L)	6.67 L/ha	2.7 L/ac	
paraquat	1.1 kg/ha		• Apply in 1000 L/ha water (400 L/ac). • For spot spraying, apply 55mL GRAMOXONE/10L water sprayed to wet weed foliage. • Direct spray at base of canes in the spring before new shoots emerge.
GRAMOXONE (200 g/L)	5.5 L/ha	2.2 L/ac	
paraquat	1.1 kg/ha		• For emerged weeds with residual control of germinating weeds. • Apply as a directed spray to established plantings. • **Do NOT** spray young raspberry shoots. • Use 1000 L/ha water (400 L/ac) to wet weed foliage. • Use lower rates for coarse, sandy soil. • Use higher rates for clay or higher organic matter soil.
GRAMOXONE (200 g/L)	5.5 L/ha	2.2 L/ac	
plus simazine	1.8 to 2.25 kg/ha		
PRINCEP NINE-T (90WG)	2 to 2.5 kg/ha	0.8 to 1 kg/ac	

* Various formulations are available, see Table 1. See label for specific uses and rates.

Strawberries — First (Planting) Year

Cultural Weed Control — See **CULTURAL WEED CONTROL IN FRUIT AND ORNAMENTAL CROPS** section.
Use straw mulch that is free of weed seeds to avoid importing weeds into the field. The mulch should be spread between the rows when it is pulled off the plants in the spring to provide additional weed control.

Site Preparation Before Planting – See Chapter 6, Special Methods of Weed Control

Recommended rates /ha or /ac refer to area actually treated with herbicide.

PREEMERGENCE — Rainfall at 15–20 mm within 7–10 days after application is necessary to activate preemergence treatments. Shallow cultivation, or harrowing will control weed escapes and improve herbicide activity in the absence of rainfall.
CAUTION: DEVRINOL and SINBAR residues, high enough to harm many crops, may persist for several years after removal of a planting.

Strawberries – First (Planting) Year — Before Planting (Soil Applied Grass and Broadleaf Herbicides)

metolachlor	1.14 to 1.6 kg/ha		• PPI or PRE — Apply and incorporate, or apply post-transplanting before weeds emerge. • Apply **ONLY** once per year. • Apply by ground application equipment **ONLY**. • **Do NOT** apply to cultivar Joliette. • **Do NOT** harvest berries from varieties bearing fruit in year of planting.
DUAL MAGNUM (915 g/L)	1.25 to 1.75 L/ha	0.5 to 0.7 L/ac	

Active ingredient TRADE NAME (Formulation)	RATE (active) PRODUCT PER HA	RATE PRODUCT PER ACRE	PRECAUTIONS For more information, see Chapter 4, Notes on Herbicides and Chapter 5, Notes on Adjuvants
trifluralin	0.6 to 1.155 kg/ha		▪ PPI— Apply to weed free soil and incorporate immediately in 2 directions.
TREFLAN EC (480 g/L)	1.25 to 2.4 L/ha	0.5 to 0.96 L/ac	▪ May be applied and incorporated 1 day to 3 weeks before planting.
RIVAL EC (500 g/L)	1.2 to 2.2 L/ha	0.48 to 0.94 L/ac	▪ May delay establishment under stressful conditions.
BONANZA 400 (400 g/L)	1.5 to 2.75 L/ha	0.6 to 1.1 L/ac	
Strawberries — First (Planting) Year — 2 to 4 Weeks After Planting (Soil Applied Grass and Broadleaf Herbicides)			
napropamide	4.5 kg/ha		▪ PRE — Apply once per season before weeds emerge or following a cultivation.
DEVRINOL DF (50 DF)	9 kg/ha	3.6 kg/ac	▪ Incorporation by rainfall, irrigation or cultivation is essential. ▪ Where daughter plant establishment is important, (e.g., for plant producers) delay application until desired number of daughter plants have been established. ▪ Inhibition of daughter plant roots can occur where soil moisture is low and will be minimized if irrigation is applied shortly after application.
Strawberries — First (Planting) Year — 2 to 4 Weeks After Planting (Postemergence Grass Herbicides)			
POSTEMERGENCE – Leaf stage of the weeds is critical for good weed control. Smaller weeds are generally easier to kill but there needs to be enough leaf surface to intercept the herbicide. Apply according to recommended leaf stages. Crop stage is important to optimize crop safety. Always use appropriate drift management technology.			
fluazifop-p-butyl	0.125 to 0.25 kg/ha		▪ Apply to actively growing grasses.
VENTURE L (125 g/L)	1 to 2 L/ha	0.4 to 0.8 L/ac	▪ For annual grasses, apply 1 L/ha at the 2–5 leaf stage of growth. ▪ For quackgrass, apply 2 L/ha at the 3–5 leaf stage of growth. Thorough preplant tillage will ensure more uniform quackgrass emergence. Cultivate after 7 days. ▪ Use only 1 application per season. ▪ Wait at least 14 days after application before applying SINBAR.
sethoxydim	0.15 to 0.5 kg/ha		▪ Apply to actively growing grasses.
POAST ULTRA (450 g/L) plus surfactant/solvent	0.32 to 1.1 L/ha	0.13 to 0.45 L/ac	▪ For annual grass, use 0.32 L/ha. Apply at the 1–6 leaf stage (2–5 is optimum). ▪ For volunteer grains, use 0.47 L/ha. Apply at the 1–6 leaf stage (2–5 is optimum).
MERGE	1 to 2 L/ha	0.4 to 0.8 L/ac	▪ For quackgrass, use 1.1 L/ha. Apply up to the 3–leaf stage. Thorough preplant tillage will ensure more uniform quackgrass emergence. Cultivate after 7 days. Use the high rate of MERGE for quackgrass. ▪ Use 100–200 L water/ha (40–80 L water/ac). ▪ Grasses emerging after application will not be controlled. ▪ Spray tips angled forward 45° will give better coverage. ▪ **Do NOT** use flood jet or hollow cone nozzles. ▪ **Do NOT** apply if rain is expected within 1 hr. after application. ▪ **Do NOT** apply closer than 25 days to harvest. ▪ Wait at least 14 days after application before applying SINBAR.
Strawberries — First (Planting) Year — 2 to 4 Weeks After Planting (Postemergence Broadleaf Herbicides)			
2,4–D *	0.55 kg/ha		▪ Use the amine formulation.
2,4-D (470 g/L)	1.17 L/ha	0.47 L/ac	▪ Apply in 100–200 L/ha of water (40–80 L/ac). ▪ Use low pressure and a coarse spray to minimize risk of spray drift to susceptible crops. ▪ **Do NOT** use while early runners are rooting. ▪ **Do NOT** use between mid-August and fall dormancy when flower buds are developing for next year's crop.

Strawberries — First (Planting) Year — 2 to 4 Weeks After Planting (Postemergence Grass and Broadleaf Herbicides)			
glyphosate* glyphosate (360 g/L)	0.36 kg/2 L 1 L/2 L water (33% solution)		▪ Apply with a rope wick or other similar device when weeds are 15 cm above the crop. ▪ Avoid contact with the strawberry plants. ▪ **Do NOT** apply when weeds are wet. ▪ See **Chapter 2, Selective Weed Control with Wiper Applicators.**
glyphosate* glyphosate (360 g/L)	0.36 to 0.72 kg/100 L 1 to 2 L/100 L water (1 to 2% solution)		▪ Use hand held sprayers as a spot treatment if wiper equipment is not available. ▪ Avoid contact with strawberry plant: crop in the treated area will be killed. ▪ **Do NOT** apply closer than 30 days before harvest.
Strawberries — First (Planting) Year — 4 to 6 Weeks After Planting (Soil Applied Grass and Broadleaf Herbicides)			
terbacil SINBAR (80 WP)	0.22 to 0.44 kg/ha 0.28 to 0.55 kg/ha	 0.11 to 0.22 kg/ac	▪ PRE – Apply before weeds emerge or to very small weeds. ▪ Apply when mother plants are well established but before runnering becomes extensive and new runner plants are rooting. ▪ Apply in at least 300 L/ha water (120 L/ac). ▪ Use lower rate on sandy soils low in organic matter. ▪ Use lower rate on sensitive varieties such as Kent, Bounty, Micmac, Annapolis, Glooscap and Cavendish since they may be severely injured. ▪ **Do NOT** apply to weak or diseased plants of any variety. ▪ **Do NOT** overlap spray swaths. Calibrate sprayer accurately. ▪ Shallow cultivation can be done to train runners and control escaped weeds without destroying the effectiveness of SINBAR.
Strawberries — First (Planting) Year — 4 to 8 Weeks After Planting (Postemergence Grass Herbicides)			
POSTEMERGENCE — Leaf stage of the weeds is critical for good weed control. Smaller weeds are generally easier to kill but there needs to be enough leaf surface to intercept the herbicide. Apply according to recommended leaf stages. Crop stage is important to optimize crop safety. Always use appropriate drift management technology.			
fluazifop-p-butyl VENTURE L (125 g/L)	0.125 to 0.25 kg/ha 1 to 2 L/ha	 0.4 to 0.8 L/ac	▪ Apply to actively growing grasses. ▪ For annual grasses, apply 1 L/ha at the 2–5 leaf stage of growth. ▪ For quackgrass, apply 2 L/ha at the 3–5 leaf stage of growth. Thorough preplant tillage will ensure more uniform quackgrass emergence. Cultivate after 7 days. ▪ Use **ONLY** 1 application per season. ▪ Wait at least 14 days after application before applying SINBAR.
sethoxydim POAST ULTRA (450 g/L) plus surfactant/solvent MERGE	0.15 to 0.5 kg/ha 0.32 to 1.1 L/ha 1 to 2 L/ha	 0.13 to 0.45 L/ac 0.4 to 0.8 L/ac	▪ Apply to actively growing grasses. ▪ For annual grass, use 0.32 L/ha. Apply at the 1–6 leaf stage (2–5 is optimum). ▪ For volunteer grains, use 0.47 L/ha. Apply at the 1–6 leaf stage (2–5 is optimum). ▪ For quackgrass, use 1.1 L/ha. Apply up to the 3–leaf stage. Thorough preplant tillage will ensure more uniform quackgrass emergence. Cultivate after 7 days. Use the high rate of MERGE for quackgrass. ▪ Use 100–200 L water/ha (40–80 L water/ac). ▪ Grasses emerging after application will not be controlled. ▪ Spray tips angled forward 45° will give better coverage. ▪ Do NOT use flood jet or hollow cone nozzles. ▪ Do NOT apply if rain is expected within 1 hr. after application. ▪ Wait at least 14 days after application before applying SINBAR. ▪ Do NOT apply closer than 25 days to harvest.

Active ingredient TRADE NAME (Formulation)	RATE active /PRODUCT PER HA	RATE PRODUCT PER ACRE	PRECAUTIONS For more information, see Chapter 4, Notes on Herbicides and Chapter 5, Notes on Adjuvants
Strawberries — First (Planting) Year — 4 to 6 Weeks After Planting (Postemergence Broadleaf Herbicides)			
2,4-D * 2,4-D (470 g/L)	0.55 kg/ha 1.17 L/ha	 0.47 L/ac	▪ Use the amine formulation. ▪ Apply in 100–200 L/ha of water (40–80 L/ac). ▪ Use low pressure and a coarse spray to minimize risk of spray drift to susceptible crops. ▪ **Do NOT** use while early runners are rooting. ▪ **Do NOT** use between mid-August and fall dormancy when flower buds are developing for next year's crop.
Strawberries — First (Planting) Year — 4 to 6 Weeks After Planting (Postemergence Grass and Broadleaf Herbicides)			
glyphosate* glyphosate (360 g/L)	0.36 kg/2L 1 L/2L water (33% solution)		▪ Apply with a rope wick or other similar device when weeds are 15 cm above the crop. ▪ Avoid contact with the strawberry plants. ▪ **Do NOT** apply when weeds are wet. ▪ See **Chapter 2, Selective Weed Control with Wiper Applicators.**
glyphosate* glyphosate (360 g/L)	0.36 to 0.72 kg/100 L 1 to 2 L/100 L water (1 to 2% solution)		▪ Use hand held sprayers for a spot treatment if wiper equipment is not available. ▪ Avoid contact with strawberry plant — crop in the treated area will be killed. ▪ **Do NOT** apply closer than 30 days before harvest.
Strawberries — First (Planting) Year — Late Summer/Fall (Labour Day) (Soil Applied Grass & Broadleaf Herbicides)			
napropamide DEVRINOL DF (50 DF)	4.5 kg/ha 9 kg/ha	 3.6 kg/ac	▪ PRE — Apply before weeds emerge or following a cultivation. ▪ Incorporation by rainfall or irrigation is essential. ▪ **Do NOT** apply during harvest period. ▪ **Do NOT** apply more than once per season.
terbacil SINBAR (80 WP)	0.144 to 0.22 kg/ha 0.18 to 0.28 kg/ha	 0.07 to 0.11 kg/ac	▪ PRE — Important timing for fall germinating weeds. Apply before weeds emerge or to very small weeds. ▪ Apply in at least 300 L/ha water (120 L/ac). ▪ Use lower rate on sandy soils low in organic matter ▪ Use lower rate on sensitive varieties such as Kent, Bounty, Micmac, Annapolis, Glooscap and Cavendish since they may be severely injured. ▪ **Do NOT** apply to weak or diseased plants of any variety. ▪ **Do NOT** overlap spray swaths. Calibrate sprayer accurately. ▪ Shallow cultivation can be done to train runners and control escaped weeds without destroying the effectiveness of SINBAR.
Strawberries — First (Planting) Year — Late Summer/Fall (Labour Day) (Postemergence Grass Herbicides)			
fluazifop-p-butyl VENTURE L (125 g/L)	0.125 to 0.25 kg/ha 1 to 2 L/ha	 0.4 to 0.8 L/ac	▪ Apply to actively growing grasses. ▪ For annual grasses, apply 1 L/ha at the 2–5 leaf stage of growth. ▪ For quackgrass, apply 2 L/ha at the 3–5 leaf stage of growth. Thorough preplant tillage will ensure more uniform quackgrass emergence. Cultivate after 7 days. ▪ Use **ONLY** one application per season. ▪ Wait at least 14 days after application before applying SINBAR.

sethoxydim	0.15 to 0.5 kg/ha		• Apply to actively growing grasses.
POAST ULTRA (450 g/L)	0.32 to 1.1 L/ha	0.13 to 0.45 L/ac	• For annual grass, use 0.32 L/ha. Apply at the 1–6 leaf stage (2–5 is optimum).
plus surfactant/solvent			• For volunteer grains, use 0.47 L/ha. Apply at the 1–6 leaf stage (2–5 is optimum).
MERGE	1 to 2 L/ha	0.4 to 0.8 L/ac	• For quackgrass, use 1.1 L/ha. Apply up to the 3–leaf stage. Thorough preplant tillage will ensure more uniform quackgrass emergence. Cultivate after 7 days. Use the high rate of MERGE for quackgrass.
			• Use 100–200 L water/ha (40–80 L water/ac).
			• Grasses emerging after application will not be controlled.
			• Spray tips angled forward 45° will give better coverage.
			• **Do NOT** use flood jet or hollow cone nozzles.
			• **Do NOT** apply if rain is expected within 1 hr. after application.
			• Wait at least 14 days after application before applying SINBAR.
			• **Do NOT** apply closer than 25 days to harvest.
Strawberries — First (Planting) Year — Late Summer/Fall (Labour Day) (Postemergence Grass & Broadleaf Herbicides)			
glyphosate*	0.36 kg/2 L		• Apply with a rope wick or other similar device when weeds are 15 cm above the crop.
glyphosate (360 g/L)	1 L/2 L water		• Avoid contact with the strawberry plants.
	(33% solution)		• **Do NOT** apply when weeds are wet.
			• See **Chapter 2, Selective Weed Control with Wiper Applicators.**
glyphosate*	0.36 to 0.72 kg/100 L		• Use hand held sprayers for a spot treatment if wiper equipment is not available.
glyphosate (360 g/L)	1 to 2 L/100 L water		• Avoid contact with strawberry plant — crop in the treated area will be killed.
	(1 to 2% solution)		• **Do NOT** apply closer than 30 days before harvest.
paraquat	1.1 kg/ha		• Apply to narrow strawberry rows and remove weeds between the rows.
GRAMOXONE (200 g/L)	5.5 L/ha	2.2 L/ac	• Apply in 550–1100 L/ha water (220–440 L/ac).
			• Apply on a calm day.
			• Use shields with low pressure and a spray nozzle arrangement to avoid drift.
			• Complete coverage is important. Use higher water volumes on dense vegetation.
			• Perennial weeds will only be suppressed.
			• Only emerged weeds will be controlled.
Strawberries — First (Planting) Year — Late Fall (Soil Applied Grass and Broadleaf Herbicides)			
napropamide	4.5 kg/ha		• PRE — Apply to a weed free soil surface just before mulching, but not on frozen ground.
DEVRINOL DF (50 DF)	9 kg/ha	3.6 kg/ac	• Incorporation by rainfall or irrigation is essential.
			• **Do NOT** apply more than once per season.
terbacil	0.56 to 0.68 kg/ha		• PRE — Apply to a weed free soil surface just before mulching.
SINBAR (80 WP)	0.7 to 0.85 kg/ha	0.28 to 0.34 kg/ac	• Apply in at least 300 L/ha water (120 L/ac).
			• Use low rate where it is planned to use SINBAR again in the spring.
			• Use lower rate on sandy soils low in organic matter.
			• Use lower rate on sensitive varieties such as Kent, Bounty, Micmac, Annapolis, Glooscap and Cavendish since they may be severely injured.
			• **Do NOT** apply to weak or diseased plants of any variety.
			• **Do NOT** overlap spray swaths. Calibrate sprayer accurately.

Active Ingredient TRADE NAME, Formulation	RATE Active PRODUCT PER HA	RATE PRODUCT PER ACRE	PRECAUTIONS For more information, see Chapter 4, Notes on Herbicides and Chapter 5, Notes on Adjuvants
Strawberries — Harvesting Year			
Weeds — Harvesting Year — Spring After Mulch Removal (Soil Applied Grass and Broadleaf Herbicides)			
napropamide DEVRINOL DF (50 DF)	4.5 kg/ha 9 kg/ha	 3.6 kg/ac	▪ PRE – Apply to weed free soil just after mulch is removed, but not on frozen ground. ▪ Incorporation by rainfall or irrigation is essential. ▪ **Do NOT** apply from bloom to harvest. ▪ **Do NOT** apply more than once per season.
terbacil SINBAR (80 WP)	0.22 to 0.28 kg/ha 0.28 to 0.35 kg/ha	 0.11 to 0.14 kg/ac	▪ PRE — Apply to weed free soil just after mulch is removed. ▪ Apply in at least 300 L/ha water (120 L/ac). ▪ If strawberry plants have made weak yellow growth under the mulch, wait 5–7 days until plants recover before applying SINBAR. ▪ Use low rate where SINBAR was used in the fall. ▪ Use lower rate on sandy soils low in organic matter. ▪ Use lower rate on sensitive varieties such as Kent, Bounty, Micmac, Annapolis, Glooscap and Cavendish since they may be severely injured. ▪ **Do NOT** apply to weak or diseased plants of any variety. ▪ **Do NOT** overlap spray swaths. Calibrate sprayer accurately.
Grasses — Harvesting Year — Spring After Mulch Removal (Postemergence Grass Herbicides)			
POSTEMERGENCE — Leaf stage of the weeds is critical for good weed control. Smaller weeds are generally easier to kill but there needs to be enough leaf surface to intercept the herbicide. Apply according to recommended leaf stages. Crop stage is important to optimize crop safety. Always use appropriate drift management technology.			
fluazifop-p-butyl VENTURE L (125 g/L)	0.125 to 0.25 kg/ha 1 to 2 L/ha	 0.4 to 0.8 L/ac	▪ Apply before bloom to actively growing grasses. ▪ For annual grasses, apply 1 L/ha at the 2–5 leaf stage of growth. ▪ For quackgrass, apply 2 L/ha at the 3–5 leaf stage of growth. Thorough preplant tillage will ensure more uniform quackgrass emergence. Cultivate after 7 days. ▪ Use only 1 application per season. ▪ Wait at least 14 days after application before applying SINBAR. ▪ **Do NOT** apply closer than 30 days to harvest.
sethoxydim POAST ULTRA (450 g/L) plus surfactant/solvent MERGE	0.15 to 0.5 kg/ha 0.32 to 1.1 L/ha 1 to 2 L/ha	 0.13 to 0.45 L/ac 0.4 to 0.8 L/ac	▪ Apply to actively growing grasses. ▪ For annual grass, use 0.32 L/ha. Apply at the 1–6 leaf stage (2–5 is optimum). ▪ For volunteer grains, use 0.47 L/ha. Apply at the 1–6 leaf stage (2–5 is optimum). ▪ For quackgrass, use 1.1 L/ha. Apply up to the 3–leaf stage. Thorough preplant tillage will ensure more uniform quackgrass emergence. Cultivate after 7 days. Use the high rate of MERGE for quackgrass. ▪ Use 100 to 200 L water/ha (40 to 80 L water/ac). ▪ Grasses emerging after application will not be controlled. ▪ Spray tips angled forward 45° will give better coverage. ▪ **Do NOT** use flood jet or hollow cone nozzles. ▪ **Do NOT** apply if rain is expected within 1 hr. after application. ▪ Wait at least 14 days after application before applying SINBAR. ▪ **Do NOT** apply closer than 25 days to harvest.

Strawberries — Harvesting Year — Spring After Mulch Removal (Postemergence Grass and Broadleaf Herbicides)			
glyphosate* glyphosate (360 g/L)	0.36 kg/2L 1 L/2L water (33% solution)		• Apply with a rope wick or other similar device when weeds are 15 cm above the crop. • Avoid contact with the strawberry plants. • **Do NOT** apply when weeds are wet. • See **Chapter 2, Selective Weed Control with Wiper Applicators.**
glyphosate* glyphosate (360 g/L)	0.36 to 0.72 kg/100 L 1 to 2 L/100 L water (1 to 2% solution)		• Use hand held sprayers for a spot treatment if wiper equipment is not available. • Avoid contact with strawberry plant — crop in the treated area will be killed. • **Do NOT** apply closer than 30 days before harvest.
Strawberries — Harvesting Year — Renovation (Soil Applied Grass and Broadleaf Herbicides)			
terbacil SINBAR (80 WP)	0.56 to 0.68 kg/ha 0.7 to 0.85 kg/ha	 0.28 to 0.34 kg/ac	• PRE — Apply after mowing before weeds emerge or to very small weeds. • Apply in at least 300 L/ha water (120 L/ac). • If, 2,4-D was used prior to mowing, delay applying SINBAR for at least 2 weeks. • **Do NOT** apply within 14 days of VENTURE L. • Use lower rate on sandy soils low in organic matter. • Use lower rate on sensitive varieties such as Kent, Bounty, Micmac, Annapolis, Glooscap and Cavendish since they may be severely injured. • **Do NOT** apply to weak or diseased plants of any variety. • **Do NOT** overlap spray swaths. Calibrate sprayer accurately. • Shallow cultivation can be done to train runners and control escaped weeds without destroying the effectiveness of SINBAR.
Strawberries — Harvesting Year — Renovation (Postemergence Grass Herbicides)			
fluazifop-p-butyl VENTURE L (125 g/L)	0.125 to 0.25 kg/ha 1 to 2 L/ha	 0.4 to 0.8 L/ac	• Apply before mowing to actively growing grasses. • For annual grasses, apply 1 L/ha at the 2–5 leaf stage of growth. May not control foxtail. • For quackgrass, apply 2 L/ha at the 3–5 leaf stage of growth. Thorough preplant tillage will ensure more uniform quackgrass emergence. Cultivate after 7 days. • Use **ONLY** one application per season. • Wait at least 14 days after application before applying SINBAR.
sethoxydim POAST ULTRA (450 g/L) plus surfactant/solvent MERGE	0.15 to 0.5 kg/ha 0.32 to 1.1 L/ha 1 to 2 L/ha	 0.13 to 0.45 L/ac 0.4 to 0.8 L/ac	• Apply to actively growing grasses. • For annual grass, use 0.32 L/ha. Apply at the 1–6 leaf stage (2–5 is optimum). • For volunteer grains, use 0.47 L/ha. Apply at the 1–6 leaf stage (2–5 is optimum). • For quackgrass, use 1.1 L/ha. Apply up to the 3–leaf stage. Thorough preplant tillage will ensure more uniform quackgrass emergence. Cultivate after 7 days. Use the high rate of MERGE for quackgrass. • Use 100–200 L water/ha (40–80 L water/ac). • Grasses emerging after application will not be controlled. • Spray tips angled forward 45° will give better coverage. • Do NOT use flood jet or hollow cone nozzles. • Do NOT apply if rain is expected within 1 hr. after application. • Wait at least 14 days after application before applying SINBAR. • Do NOT apply closer than 25 days to harvest.

TRADE NAME (Formulation)	RATE PRODUCT PER HA	RATE PRODUCT PER ACRE	PRECAUTIONS For more information see Chapter 4 Notes on Herbicides and Chapter 5 Notes on Adjuvants
Strawberries — Harvesting Year — Renovation (Postemergence Broadleaf Herbicides)			
2,4-D * 2,4-D (470 g/L)	1.034 kg/ha 2.2 L/ha	0.88 L/ac	• Apply after harvest but before mowing to control dandelions and other broadleaf perennials. Delay mowing for a few days after application. • Use amine formulation. • **Do NOT** apply 2,4-D between mid August and fall dormancy when strawberries are initiating flower buds. • Some cultivars like Veestar are more sensitive to 2,4-D than Redcoat.
clopyralid LONTREL 360 (360 g/L)	0.2 to 0.3 kg/ha 0.56 to 0.83 L/ha	0.22 to 0.33 L/ac	• To control tufted vetch, Canada thistle, sheep sorrel and ox-eye daisy. • Apply immediately after harvest at renovation, 7–10 days before mowing. • Apply with a boom sprayer in 150–250 L/ha of water (60–100 L/ac). • Apply once per year as a single treatment. • Early cultivars like Veestar or Annapolis may be more susceptible to injury. • Certain environment stresses such as drought, flooding or severe overwintering conditions may increase the risk of injury. • **Do NOT** apply closer than 200 days to harvest.
Strawberries — Harvesting Year — Renovation (Postemergence Grass and Broadleaf Herbicides)			
glyphosate* glyphosate (360 g/L)	0.36 kg/2L 1 L/2L water (33% solution)		• Apply with a rope wick or other similar device when weeds are 15 cm above the crop. • Avoid contact with the strawberry plants. • **Do NOT** apply when weeds are wet. • See **Chapter 2, Selective Weed Control with Wiper Applicators.**
glyphosate* glyphosate (360 g/L)	0.36 to 0.72 kg/100 L 1 to 2 L/100 L water (1 to 2% solution)		• Use hand held sprayers for a spot treatment if wiper equipment is not available. • Avoid contact with strawberry plant — crop in the treated area will be killed. • **Do NOT** apply closer than 30 days before harvest.
paraquat GRAMOXONE (200 g/L)	1.1 kg/ha 5.5 L/ha	2.2 L/ac	• Apply just after harvest to narrow rows and remove weeds between the rows. • Repeat application in the early fall (Labour Day) if required. • Apply in 550–1100 L/ha water (220–440 L/ac). • Apply on a calm day. • Use shields with low pressure and a spray nozzle arrangement to avoid drift. • Complete coverage is important. Use higher water volumes on dense vegetation. • Perennial weeds will only be suppressed. • Only emerged weeds will be controlled.
Strawberries — Harvesting Year — Late Summer/Fall (Labour Day) (Soil Applied Grass & Broadleaf Herbicides)			
napropamide DEVRINOL DF (50 DF)	4.5 kg/ha 9 kg/ha	3.6 kg/ac	• PRE — Apply before weeds emerge or following a cultivation. • Incorporation by rainfall or irrigation is essential. • **Do NOT** apply during harvest period. • **Do NOT** apply more than once per season.

terbacil SINBAR (80 WP)	0.144 to 0.22 kg/ha 0.18 to 0.28 kg/ha	 0.07 to 0.11 kg/ac	• PRE — Important timing for fall germinating weeds. Apply before weeds emerge or to very small weeds. • Apply in at least 300 L/ha water (120 L/ac). • Use lower rate on sandy soils low in organic matter. • Use lower rate on sensitive varieties such as Kent, Bounty, Micmac, Annapolis, Glooscap and Cavendish since they may be severely injured. • **Do NOT** apply to weak or diseased plants of any variety. • **Do NOT** overlap spray swaths. Calibrate sprayer accurately. • Shallow cultivation can be done to train runners and control escaped weeds without destroying the effectiveness of SINBAR.
Strawberries — Harvesting Year — Late Summer/Fall (Labour Day) (Postemergence Grass Herbicides)			
fluazifop-p-butyl VENTURE L (125 g/L)	0.125 to 0.25 kg/ha 1 to 2 L/ha	 0.4 to 0.8 L/ac	• Apply to actively growing grasses. • For annual grasses, apply 1 L/ha at the 2–5 leaf stage of growth. • For quackgrass, apply 2 L/ha at the 3–5 leaf stage of growth. Thorough preplant tillage will ensure more uniform quackgrass emergence. Cultivate after 7 days. • Use **ONLY** one application per season. • Wait at least 14 days after application before applying SINBAR.
sethoxydim POAST ULTRA (450 g/L) plus surfactant/solvent MERGE	0.15 to 0.5 kg/ha 0.32 to 1.1 L/ha 1 to 2 L/ha	 0.13 to 0.45 L/ac 0.4 to 0.8 L/ac	• Apply to actively growing grasses. • For annual grass, use 0.32 L/ha. Apply at the 1–6 leaf stage (2–5 is optimum). • For volunteer grains, use 0.47 L/ha. Apply at the 1–6 leaf stage (2–5 is optimum). • For quackgrass, use 1.1 L/ha. Apply up to the 3–leaf stage. Thorough preplant tillage will ensure more uniform quackgrass emergence. Cultivate after 7 days. Use the high rate of MERGE for quackgrass. • Use 100–200 L water/ha (40–80 L water/ac). • Grasses emerging after application will not be controlled. • Spray tips angled forward 45° will give better coverage. • **Do NOT** use flood jet or hollow cone nozzles. • **Do NOT** apply if rain is expected within 1 hr. after application. • Wait at least 14 days after application before applying SINBAR. • **Do NOT** apply closer than 25 days to harvest.
Strawberries — Harvesting Year — Late Summer/Fall (Labour Day) (Postemergence Grass & Broadleaf Herbicides)			
glyphosate* glyphosate (360 g/L)	0.36 kg/2L 1 L/2L water (33% solution)		• Apply with a rope wick or other similar device when weeds are 15 cm above the crop. • Avoid contact with the strawberry plants. • **Do NOT** apply when weeds are wet. • See **Chapter 2, Selective Weed Control with Wiper Applicators.**
glyphosate* glyphosate (360 g/L)	0.36 to 0.72 kg/100 L 1 to 2 L/100 L water (1 to 2% solution)		• Use hand held sprayers for a spot treatment if wiper equipment is not available. • Avoid contact with strawberry plant — crop in the treated area will be killed. • **Do NOT** apply closer than 30 days before harvest.

Active ingredient TRADE NAME Formulation*	RATE (active) PRODUCT PER HA	RATE PRODUCT PER ACRE	PRECAUTIONS For more information, see Chapter 4 Notes on Herbicides and Chapter 5 Notes on Adjuvants
paraquat GRAMOXONE (200 g/L)	1.1 kg/ha 5.5 L/ha	2.2 L/ac	▪ Apply to narrow rows and remove weeds between the rows. ▪ Apply in 550–1100 L/ha water (220–440 L/ac). ▪ Apply on a calm day. ▪ Use shields with low pressure and a spray nozzle arrangement to avoid drift. ▪ Complete coverage is important. Use higher water volumes on dense vegetation. ▪ Perennial weeds will only be suppressed. ▪ Only emerged weeds will be controlled.
Herbicides — Harvesting Year — Late Fall (Soil Applied Grass and Broadleaf Herbicides)			
napropamide DEVRINOL DF (50 DF)	4.5 kg/ha 9 kg/ha	3.6 kg/ac	▪ PRE — Apply to a weed free soil surface just before mulching, but not on frozen ground. ▪ Incorporation by rainfall or irrigation is essential. ▪ **Do NOT** apply more than once per season.
terbacil SINBAR (80 WP)	0.56 to 0.68 kg/ha 0.7 to 0.85 kg/ha	0.28 to 0.34 kg/ac	▪ PRE — Apply to a weed free soil surface just before mulching. ▪ Apply in at least 300 L/ha water (120 L/ac). ▪ Use low rate where it is planned to use SINBAR again in the spring. ▪ Use lower rate on sandy soils low in organic matter. ▪ Use lower rate on sensitive varieties such as Kent, Bounty, Micmac, Annapolis, Glooscap and Cavendish since they may be severely injured. ▪ **Do NOT** apply to weak or diseased plants of any variety. ▪ **Do NOT** overlap spray swaths. Calibrate sprayer accurately.

* Various formulations are available, see Table 1. See label for specific uses and rates.

Notes:

Weed control ratings are given as 0–9 where 0 indicates no control and 9 indicates 90%–100% control under ideal conditions.
Ratings are subjective values based on best available information and give general comparisons based on use as descibed in this guide.
Under unfavorable conditions (eg., too dry, too wet, too cold, or poor application) the herbicides may not be as effective as indicated.
Ratings may vary with weed and crop stage and with the timing and rates of the product(s) being used.
Ratings in **BOLD** indicate the weed is listed on the product label for control or suppression.
Please see product label for more information on registered weed species, product uses and precautions.

TABLE 22. Strawberry Herbicide Weed Control Ratings

Trade Name	Annual Grasses						Annual Broadleaves									Perennial Weeds																		
	barnyard grass	crabgrass	fall panicum	foxtails	old witch grass	volunteer grains	chickweed, common	groundsel	lady's-thumb	lamb's-quarters	mustards	pigweeds	ragweed	snapdragon, dwarf	violet, field (field pansy)	bindweeds	brome grass	chickweed, mouse-eared	daisy, ox-eye	dandelion	ground-ivy (creeping-charlie)	mallow	milkweed	nutsedge	plantains	poison-ivy	quackgrass	sorrel, sheep	sow-thistle	thistle, Canada	toadflax, yellow	vetches
BONANZA, TREFLAN, RIVAL	**8**	**9**	8	**9**	8	9	8	3	7	**8**	3	**8**	4	?	?	0	?	5	0	0	0	0	0	9	0	0	0	0	0	0	0	0
DEVRINOL	**8**	**9**	**8**	**8**	**8**	8	8	**8**	6	**8**	5	**8**	**6**	0	0	8	8	?	?	2	?	?	5	5	2	?	5	0	5	5	?	0
DUAL MAGNUM	**9**	**9**	**9**	**9**	**9**	?	?	?	2	7	2	**7/8**	4	?	?	0	?	?	?	5	?	?	0	**8**	5	?	4	?	0	0	?	0
SINBAR	**8**	7	8	**8**	8	8	**8**[a]	5	7[a]	**8**[a]	**8**[a]	7[a]	7[a]	2	5[a]	?	8	?	2	5	?	?	6	**6**	8	?	**6**	8	5	6	2	2
VENTURE L	**9**	**9**	**9**	**9**	**9**	9	0	0	0	0	0	0	0	0	0	0	9	0	0	0	0	0	0	0	0	0	**7**	0	0	0	0	0
POAST + MERGE	**9**	**8**	**9**	**9**	**9**	**9**	0	0	0	0	0	0	0	0	0	0	?	0	0	0	0	0	0	0	0	0	**6**	0	0	0	0	0
2,4-D*	0	0	0	0	0	0	**7**	2	**6**	**8**	**9**	**7**	**8**	2	2	2	0	2	2	**8**	2	0	0	0	**8**	?	0	8	6	**8**	?	5
LONTREL 360	0	0	0	0	0	0	0	8	?	5	?	5	9	?	?	0	0	0	**8**	8	0	0	0	0	0	0	0	**9**	8[b]	**9**	0	**9**
GRAMOXONE	**9**	**9**	**9**	**9**	**9**	**9**	**9**	**9**	**9**	**9**	**9**	**9**	**9**	**9**	**9**	**8**[b]	**8**[b]	**8**[b]	**8**[b]	**8**[b]	**8**[b]	**8**[b]	**8**[b]	**8**[b]	**8**[b]	**8**[b]	**8**[b]	**8**[b]	**8**[b]	**8**[b]	**8**[b]	**8**[b]	**8**[b]
CREDIT, GLYPHOS, ROUNDUP, TOUCHDOWN, VANTAGE [1]	**9**	**9**	**9**	**9**	**9**	**9**	**9**	**8**	**9**	**8**	**9**	**9**	**8**	?	?	**7/8**	9	**9**	?	**8**	5	**5**	**9**	**8**	**9**	**9**	**8**	**8**	**9**	**9**	**8**	5[a]

* Various products are available, see Table 1.
? Insufficient information available to make a rating
[1] Spot treatment only
[a] Low rates and single applications may provide less control.
[b] Top growth only; regrowth can be expected. Repeated treatments may provide control.

CHAPTER 15. TREE FRUIT & GRAPES

Cultural Weed Control in Fruit Crops

A successful weed control program must integrate cultural and chemical weed control practices. Growers cannot depend entirely on chemical weed control in fruit crops, since there is a limited spectrum of herbicides registered for these crops.

PERENNIAL WEED CONTROL

It is important to identify and control perennial weeds in the preplanting year. It is very difficult to control perennial weeds once a planting is established because of crop sensitivity to some herbicides and since it is not possible to clean cultivate in established orchards, vineyards, berry crops and nurseries.

The following perennial weeds present serious problems in these crops; quackgrass, bindweed, vetch, wild grape, perennial nightshade, thistles, ground-ivy (creeping Charlie) and burdock. In strawberries, sheep sorrel, toadflax and milkweed also present problems.

Systemic herbicides such as glyphosate (eg. ROUNDUP) or amitrole (eg. AMITROL 240) should be applied to perennial weeds in the preplanting year. Consult the product label and be sure to use the recommended rate for the weed in question. Apply the herbicide at the proper stage of growth of the weed, otherwise only temporary control will be achieved. Repeated cultivations of some perennial weeds such as bindweed will also provide control.

SITE PREPARATION

A green manure crop such as perennial rye-grass or Sudan grass should be established in the preplanting year following or in conjunction with measures to control perennial weeds. This crop will provide competition to reduce weed growth as well as improving the soil structure. Non-selective herbicides can be applied before planting the green manure crop and before plowing it under. Short residual selective herbicides such as 2,4--D may be used with the green manure crop, but avoid using herbicides that leave a soil residue that will carry over into the planting year. See Chapter 6, Site Preparation.

MULCHING

A biodegradable plastic mulch could be used for weed control in the planting strip. A straw mulch will also assist in weed control beneath the trees or in the planting strip if it is applied early in the season before the weed seeds germinate. Use mulch that is free of weed seeds and ensure that enough nitrogen is provided for the plants. The mulch should be pulled away from around the tree bases for winter rodent protection. Peastone gravel is another option that can be applied around the base of the trees. It will provide weed control as well as improving drainage, encouraging deeper rooting and discouraging rodents.

REDUCING WEED PRESSURE

Cultivation can provide weed control between the rows. Alternatively, a vigorous sod between the rows will prevent weeds from becoming established. It is better to seed in a fescue sod than to rely on a natural sod composed of weed and grass species, since the weeds will seed into the herbicide strip.

Prevent weeds from setting seed in adjacent uncropped areas by using cultural or chemical weed control measures. Mowing at regular intervals will prevent many weeds from flowering. Try to control weeds that escape before they set seed, by cultural removal or chemical mowing. In some situations, tools such as a weed whip may be of use. Mowers are available which will cut close to the trees without injury. Mowing, however, will not eliminate weed competition.

ROTATING HERBICIDE FAMILIES

(See Table 3, Herbicide Groupings in Ontario)

In perennial crops, rotation of herbicide families is important to minimize the building up of seed from weed escapes, including triazine tolerant weeds. Rotation will also help avoid an accumulation of herbicide residues in the soil that may result in crop injury over a period of years and may hinder replanting.

Apples

Site Preparation Before Planting — See Chapter 6, Special Methods of Weed Control

Recommended rates /ha or /ac refer to area actually treated with herbicide. Unless specified, apply all treatments in 150–300 L/ha (60–120 L/ac) water.

PREPLANT INCORPORATED (PPI) — Two incorporations at right angles operating at a depth of 10 cm using a double disk (7–10 km/hr) or vibrating shank S-tine cultivator (10–13 km/hr) are required unless otherwise stated. Cultivation-type equipment used for herbicide incorporation is known to spread perennial weeds to previously uninfested areas. Special attention should be directed toward machinery cleanliness, and/or treating fields with perennial weeds last.

PREEMERGENCE (PRE) — Rainfall at 15–20 mm within 7–10 days after application is necessary to activate preemergence treatments. Shallow cultivation, or harrowing will control weed escapes and improve herbicide activity in the absence of rainfall.

CAUTION — Simazine, DEVRINOL and SINBAR residues, high enough to harm many crops, may persist for several years after removal of orchard.

Active Ingredient TRADE NAME (Formulation)	RATE (active) PRODUCT PER HA	RATE PRODUCT PER ACRE	PRECAUTIONS For more information see Chapter 4 Notes on Herbicides and Chapter 5 Notes on Adjuvants
Apples — Year of Planting (Soil Applied Grass & Broadleaf Herbicides)			
dichlobenil CASORON 4G (4 Gr)	4.4 to 7 kg/ha 110 to 175 kg/ha	 44 to 70 kg/ac	▪ PRE — Apply to cool, moist soil in spring before weeds emerge or after cultivation. ▪ **Do NOT** apply if air temps are above 10–15°C to avoid injury from volatilization. ▪ **Do NOT** apply until 4 weeks after transplanting. ▪ **Do NOT** use on light sandy soils. ▪ 70 g of CASORON 4G applied to an area 2x2 m is equivalent to 175 kg/ha (70 kg/ac).
metribuzin LEXONE DF (75 DF)	0.38 to 0.75 kg/ha 0.5 to 1 kg/ha	 0.2 to 0.4 kg/ac	▪ PPI before planting trees. ▪ Make a single application as an orchard floor or planting row treatment.
metribuzin SENCOR 75 DF (75 WG) plus trifluralin TREFLAN EC(480 g/L) BONANZA 400 (400 g/L)	0.42 to 0.56 kg/ha 0.55 to 0.75 kg/ha 0.6 to 1.155 kg/ha 1.25 to 2.4 L/ha 1.5 to 2.75 L/ha	 0.22 to 0.3 kg/ac 0.5 to 0.96 L/ac 0.6 to 1.1 L/ac	▪ PPI before planting trees as an orchard floor or planting row treatment. ▪ Apply once in the planting year **ONLY**.
napropamide DEVRINOL DF (50 DF)	4.5 kg/ha 9 kg/ha	 3.6 kg/ac	▪ PRE — Apply after planting trees, but before weeds emerge. ▪ Use a directed spray at low pressure. ▪ Incorporation by rainfall or irrigation is essential within 2 days of application.
napropamide DEVRINOL DF (50 DF) plus simazine PRINCEP NINE-T (90WG)	3.5 kg/ha 7 kg/ha 2.025 kg/ha 2.25 kg/ha	 2.8 kg/ac 0.9 kg/ac	▪ PRE — Apply in the fall through early spring before weeds emerge. ▪ **Do NOT** apply on frozen ground or during harvest. ▪ Make **ONLY** one application in the planting year. ▪ Incorporation by rainfall or irrigation is essential within 2 days of application.
napropamide DEVRINOL DF (50 DF) plus terbacil SINBAR (80 WP)	4.5 kg/ha 9 kg/ha 0.5 kg/ha 0.63 kg/ha	 3.6 kg/ac 0.25 kg/ac	▪ PRE — Apply in the fall through early spring before weeds emerge. ▪ **Do NOT** apply on frozen ground or during harvest. ▪ Make 1 application in the planting year **ONLY**. ▪ Incorporation by rainfall or irrigation is essential within 2 days of application.

Active ingredient TRADE NAME Formulation	RATE /active PRODUCT PER HA	RATE PRODUCT PER ACRE	PRECAUTIONS For more information, see Chapter 4 Notes on Herbicides and Chapter 6 Notes on Adjuvants
s-metolachlor DUAL MAGNUM (915 g/L) plus simazine PRINCEP NINE-T (90WG) SIMAZINE 80W (80WP)	1.14 to 1.6 kg/ha 1.25 to 1.75 L/ha 0.99 to 1.98 kg/ha 1.1 to 2.2 kg/ha 1.25 to 2.5 kg/ha	 0.5 to 0.7 L/ac 0.44 to 0.88 kg/ac 0.5 to 1 kg/ac	• PRE — Apply post planting, before weeds emerge, preferably after rain has settled the soil around the trees. • Apply once in the year of planting. • **Do NOT** use on sandy soils with less than 2% organic matter. • Avoid contact with tree trunks and leaves.
simazine PRINCEP NINE-T (90WG) SIMAZINE 80W (80WP)	1 to 2 kg/ha 1.1 to 2.2 kg/ha 1.25 to 2.5 kg/ha	 0.44 to 0.88 kg/ac 0.5 to 1 kg/ac	• PRE — Apply post planting, preemergent to weeds, preferably after rain has settled the soil around the trees. • Apply once per season. • Avoid contact with trunk and leaves of trees. • **Do NOT** use on sandy soils with less than 2% organic matter.
terbacil SINBAR (80 WP)	1 kg/ha 1.25 kg/ha	 0.5 kg/ac	• PRE — Apply after planting trees, before weeds emerge. • **Do NOT** use on soils with less than 2% organic matter. • Avoid contact with tree trunks and leaves.
trifluralin TREFLAN EC (480 g/L) BONANZA 400 (400 g/L)	0.6 to 1.155 kg/ha 1.25 to 2.4 L/ha 1.5 to 2.75 L/ha	 0.5 to 0.96 L/ac 0.6 to 1.1 L/ac	• PPI — Apply and incorporate before planting trees. • Apply once in the planting year **ONLY**. • Use at least 100 L/ha water (40 L/ac).
Apples — Year of Planting (Postemergent Grass Herbicides)			
POSTEMERGENCE — Leaf stage of the weeds is critical for good weed control. Smaller weeds are generally easier to kill but there needs to be enough leaf surface to intercept the herbicide. Apply according to recommended leaf stages. Crop stage is important to optimize crop safety. Adjuvants will frequently improve the weed control when used as directed. Weather or other conditions may influence the optimum rate of adjuvant, see the product label for more details. Always use appropriate drift management technology.			
fluazifop-p-butyl VENTURE L (125 g/L)	0.125 to 0.25 kg/ha 1 L to 2 L /ha	 0.4 to 0.8 L/ac	• Apply to actively growing grasses. • For annual grasses, use 1 L/ha. Apply at the 2–6 leaf stage. • For quackgrass, use 2 L/ha. Apply at the 3–5 leaf stage. • **Do NOT** apply more than once per year. • Grasses emerging after the treatment will not be controlled.
sethoxydim POAST ULTRA (450 g/L) plus surfactant/solvent MERGE	0.15 to 0.5 kg/ha 0.32 to 1.1 L/ha 1 to 2 L/ha	 0.13 to 0.45 L/ac 0.4 to 0.8 L/ac	• Apply to actively growing grasses. • For annual grass, use 0.32 L/ha. Apply at the 1–6 leaf stage. • For volunteer grains, use 0.47 L/ha. • For quackgrass, use 1.1 L/ha. Apply up to the 3–leaf stage. • **Do NOT** apply closer than 25 days to harvest.
Apples — Year of Planting (Postemergent Broadleaf Herbicides)			
bentazon BASAGRAN (480 g/L) plus oil concentrate ASSIST	0.84 to 1.08 kg/ha 1.75 to 2.25 L/ha 1 to 2 L/ha	 0.7 to 0.9 L/ac 0.4 to 0.8 L/ac	• Direct under trees to small actively growing weeds. • Apply in 100–400 L/ha water (40–160 L/ac) with at least 275 kPa pressure. • Avoid tree leaves. • Use lower rate of ASSIST under hot, humid conditions. • Make 2 applications, 10 days apart at the low rate, in the planting year **ONLY**.
clopyralid LONTREL 360 (360 g/L)	0.202 kg/ha 0.56 L/ha	 0.22 L/ac	• For control of vetch at early flowering stage. • Apply in the spring as a spot treatment. • Avoid contact with tree limbs. • **Do NOT** apply closer than 30 days to harvest.

Apples — Established Planting (Soil Applied Grass Herbicides)			
propyzamide KERB (50 WP)	2.25 kg/ha 4.5 kg/ha	 1.8 kg/ac	▪ PRE — Apply from late September to early November when soil is cool and moist but not frozen. ▪ Use **ONLY** under apple trees established at least 1 year. ▪ 4.5 kg/ha is equivalent to 45 g/100 m².
s-metolachlor DUAL MAGNUM (915 g/L)	1.6 kg/ha 1.75 L/ha	 0.7 L/ac	▪ PRE — Apply once per year as a band treatment under the trees before weeds emerge. ▪ Avoid contact with trunk and leaves of trees. ▪ **Do NOT** use on sandy soil with less than 2% organic matter.
Apples — Established Planting (Soil Applied Broadleaf Herbicides)			
metribuzin LEXONE DF (75 DF)	0.75 kg/ha 1 kg/ha	 0.4 kg/ac	▪ PRE — Apply once per year as a band treatment under the trees before weeds emerge. ▪ Avoid contact with tree trunks and leaves.
Apples — Established Planting (Soil Applied Grass & Broadleaf Herbicides)			
dichlobenil CASORON 4G (4Gr)	4.4 to 7 kg/ha 110 to 175 kg/ha	 44 to 70 kg/ac	▪ PRE — Apply to cool moist but unfrozen soil in late fall or spring before weeds emerge. ▪ **Do NOT** apply if air temps are above 10–15°C to avoid injury from volatilization. ▪ **Do NOT** use on light sandy soils. ▪ 70 g of CASORON 4G applied to an area 2x2 m is equivalent to 175 kg/ha (70 kg/ac).
linuron LOROX DF (50 DF) AFOLAN F (480 g/L) LINURON 480 (480 g/L)	4.5 kg/ha 9 kg/ha 9.4 L/ha 9.4 L/ha	 3.6 kg/ac 3.76 L/ac 3.76 L/ac	▪ PRE — Apply as directed spray before weeds are 10 cm high. ▪ Apply in 400–600 L/ha water (160–240 L/ac). ▪ Add a surfactant. ▪ Avoid contact with fruit, foliage or tree bark with spray or drift. ▪ Use **ONLY** under trees established at least 10 years.
napropamide DEVRINOL DF (50 DF)	4.5 kg/ha 9 kg/ha	 3.6 kg/ac	▪ PRE — Apply in the fall through early spring before weeds emerge, but not on frozen ground. ▪ Avoid contact with fruit and foliage. ▪ **Do NOT** apply when fruit is on the ground during harvest. ▪ Incorporation by rainfall or irrigation is essential.
s-metolachlor DUAL MAGNUM (915 g/L) plus metribuzin LEXONE DF (75 DF)	1.6 kg/ha 1.75 L/ha 0.75 kg/ha 1 kg/ha	 0.7 L/ac 0.4 kg/ac	▪ PRE — Apply once per year as a band treatment under the trees before weeds emerge. ▪ Avoid contact with trunk and leaves of trees. ▪ **Do NOT** use on sandy soil with less than 2% organic matter.
s-metolachlor DUAL MAGNUM (915 g/L) plus simazine PRINCEP NINE-T (90WG)	1.6 kg/ha 1.75 L/ha 2.25 kg/ha 2.5 kg/ha	 0.7 L/ac 1 kg/ac	▪ PRE — Apply once per year as a band treatment under the trees before weeds emerge. ▪ Avoid contact with trunk and leaves of trees. ▪ **Do NOT** use on sandy soil with less than 2% organic matter. ▪ Late season crabgrass and fall panicum may escape this treatment.
simazine PRINCEP NINE-T (90WG) SIMADEX (500 g/L) SIMAZINE 480 (480 g/L)	2.25 to 4.5 kg/ha 2.5 to 5 kg/ha 4.5 to 9 L/ha 4.7 to 9.4 L/ha	 1 to 2 kg/ac 1.8 to 3.6 L/ac 1.88 to 3.76 L/ac	▪ PRE — Apply in 300–1000 L/ha water (120–400 L/ac). ▪ Use only under trees planted for 1 year or more. ▪ Use higher rate on perennial weeds such as quackgrass. ▪ May be combined with glyphosate.
terbacil SINBAR (80 WP)	1.8 to 3.6 kg/ha 2.25 to 4.5 kg/ha	 0.9 to 1.8 kg/ac	▪ PRE — Apply in 1000 L/ha water (400 L/ac). ▪ Use only under trees established for at least 3 years.

Active ingredient TRADE NAME (Formulation)	RATE (active) PRODUCT PER HA	RATE PRODUCT PER ACRE	PRECAUTIONS For more information see Chapter 4 Notes on Herbicides and Chapter 5 Notes on Adjuvants
terbacil	0.5 kg/ha		▪ PRE — Apply as a band under trees before weeds emerge.
SINBAR (80 WP)	0.63 kg/ha	0.25 kg/ac	▪ Use only 1 application per year.
plus metribuzin	0.75 kg/ha		▪ **Do NOT** use on soil coarser than sandy loams with less than 3% organic matter.
LEXONE DF (75 DF)	1 kg/ha	0.4 kg/ac	
Apples — Established Planting (Postemergence Grass Herbicides)			
POSTEMERGENCE — Leaf stage of the weeds is critical for good weed control. Smaller weeds are generally easier to kill but there needs to be enough leaf surface to intercept the herbicide. Apply according to recommended leaf stages. Crop stage is important to optimize crop safety. Adjuvants will frequently improve the weed control when used as directed. Weather or other conditions may influence the optimum rate of adjuvant, see the product label for more details. Always use appropriate drift management technology.			
fluazifop-p-butyl	0.125 to 0.25 kg/ha		▪ Apply to actively growing grasses.
VENTURE L (125 g/L)	1 L to 2 L /ha	0.4 to 0.8 L/ac	▪ For annual grasses, use 1 L/ha. Apply at the 2–6 leaf stage. ▪ For quackgrass, use 2 L/ha. Apply at the 3–5 leaf stage. ▪ **Do NOT** apply more than once per year. ▪ Grasses emerging after the treatment will not be controlled.
sethoxydim	0.15 to 0.5 kg/ha		▪ Apply to actively growing grasses.
POAST ULTRA (450 g/L)	0.32 to 1.1 L/ha	0.13 to 0.45 L/ac	▪ For annual grass, use 0.32 L/ha. Apply at the 1–6 leaf stage.
plus surfactant/solvent			▪ For volunteer grains, use 0.47 L/ha.
MERGE	1 to 2 L/ha	0.4 to 0.8 L/ac	▪ For quackgrass, use 1.1 L/ha. Apply up to the 3–leaf stage. ▪ **Do NOT** apply closer than 25 days to harvest.
Apples — Established Planting (Postemergence Broadleaf Herbicides)			
2,4-D	0.95 kg/ha		▪ For broadleaf weeds, including dandelion, seedling Canada thistle and sow thistle.
2,4-D AMINE 600 (560 g/L)	1.7 L/ha	0.68 L/ac	▪ Apply in early spring after weeds emerge or postharvest to actively growing weeds. ▪ **Do NOT** apply when useable fruit is on the orchard floor. ▪ **Do NOT** apply closer than 80 days to harvest.
clopyralid	0.202 kg/ha		▪ For control of emerged vetch at early flowering.
LONTREL 360 (360 g/L)	0.56 L/ha	0.22 L/ac	▪ Apply in the spring of vetch as a spot treatment. ▪ Avoid contact with tree limbs. ▪ **Do NOT** apply closer than 30 days to harvest.
Apples — Established Planting (Postemergence Grass & Broadleaf Herbicides)			
amitrole	2.25 to 3.25 kg/ha		▪ For all emerged weeds including poison ivy.
AMITROL 240 (231 g/L)	9.4 to 13.5 L/ha	3.76 to 5.4 L/ac	▪ Spray to wet entire weed to the ground after foliage has fully developed. ▪ Keep spray off tree trunks as much as possible. ▪ **Do NOT** apply closer than 30 days before harvest.
glufosinate ammonium	0.405 to 0.75 kg/ha		▪ Apply as a directed spray before weeds are 30 cm high.
IGNITE (150 g/L)	2.7 to 5 L/ha	1.08 to 2 L/ac	▪ Use 110 to 330 L/ha water (44–132 L/ac). ▪ Where weed growth is heavy, use the higher rate and larger water volume. ▪ **Do NOT** apply closer than 40 days to harvest. ▪ For trees established at least 1 year.

glufosinate ammonium IGNITE (150 g/L) plus simazine PRINCEP NINE-T (90WG) SIMADEX (500 g/L)	0.405 to 0.75 kg/ha 2.7 to 5 L/ha 2.25 to 4.5 kg/ha 2.5 to 5 kg/ha 4.5 to 9 L/ha	 1.08 to 2 L/ac 1 to 2 kg/ac 1.8 to 3.6 L/ac	▪ To control emerged weeds plus residual control of annual grasses and broadleaf weeds. ▪ Use as a directed spray around the bases of trees established at least 1 year. ▪ **Do NOT** apply closer than 40 days to harvest. ▪ See Precautions on IGNITE and PRINCEP.
glyphosate ROUNDUP (356 g/L) plus simazine PRINCEP NINE-T (90WG) SIMAZINE 80W (80WP)	0.8 to 4.27 kg/ha 2.25 to 12 L/ha 2 to 4.5 kg/ha 2.25 to 5 kg/ha 2.5 to 5 kg/ha	 0.9 to 4.8 L/ac 0.9 to 2 kg/ac 1 to 2 kg/ac	▪ To control actively growing weeds, with residual control of germinating weeds. ▪ Apply in 200–300 L/ha water (80–120 L/ac) as a directed spray. ▪ Remove all suckers from base of trunks before application. ▪ **Do NOT** apply to trees with "green" bark in the area of application. ▪ See Precautions on ROUNDUP and PRINCEP.

glyphosate*
glyphosate (360 g/L)
 	
* Various formulations are available, see Table 1. See label for specific uses and rates.
	0.81 to 4.32 kg/ha
	2.25 to 12 L/ha
		
		0.9 to 4.8 L/ac
			▪ For actively growing weeds.
			▪ Apply in 200–300 L/ha water (80–120 L/ac) as a directed spray.
			▪ Remove all suckers from base of trunks before application.
			▪ **Do NOT** apply to trees with "green" bark in the area of application.
			▪ **Do NOT** mow or till weeds for at least 5–7 days after application. Wait longer if cool.
			▪ Only weeds emerged at application time will be controlled. Additional weed control programs will be necessary to control weeds germinating later.
			▪ Repeat application to regrowth may be necessary for complete control.
			▪ For **annual weeds**, use 2.25 to 3.5 L product/ha (0.9 to 1.4 L/ac).
			  ▪ Use 50–100 L/ha water (20–40 L/ac) for the low rate, or use a surfactant with larger water volumes.
			  ▪ Water volumes of 100–300 L/ha water (40–120 L/ac) can be used with the 3.5 L/ha rate.
			▪ For **dandelions and quackgrass**, use 2.5 to 7 L product /ha (1 to 2.8 L/ac).
			  ▪ Apply when plants have at least 3–4 new leaves.
			  ▪ The low rate (2.5 L/ha (1 L/ac)) will provide a minimum of 1 season control while higher rates (4.75 to 7 L/ha (1.9 to 2.8 L/ac)) will provide longer term control.
			  ▪ For dandelion control apply 2.5 L/ha (1 L/ac) if 15 cm or less in diameter and 3.5 to 5 L/ha (1.4 to 2 L/ac) if larger than 15 cm.
			▪ For **perennial broadleaf weeds**, use 7 to 12 L product/ha (2.8 to 4.8 L/ac)
			  ▪ Canada thistle and sow-thistle should be at least in early bud, milkweed at bud, bindweed at full flower, and dogbane past full bloom for best results.
			▪ **Do NOT** apply closer than 30 days to harvest.

glyphosate* glyphosate (360 g/L)	0.36 kg/2L 1 L/2L water (33% solution)		▪ Apply with a rope wick or other similar device when weeds are at the optimum stage. ▪ Avoid contact with the leaves, trucks and suckers. ▪ **Do NOT** apply when weeds are wet. ▪ See **Chapter 2, Selective Weed Control with Wiper Applicators.** ▪ **Do NOT** apply closer than 30 days to harvest.

Active ingredient TRADE NAME Formulation	RATE (active) PRODUCT PER HA	RATE PRODUCT PER ACRE	PRECAUTIONS For more information see Chapter 4 Notes on Herbicides and Chapter 5 Notes on Adjuvants
glyphosate* glyphosate (360 g/L)	0.36 to 0.72 kg/100 L 1 to 2 L/100 L water (1 to 2% solution)		• Use hand held sprayers as a spot treatment if wiper equipment is not available. • Avoid contact with leaves, trucks and suckers. • **Do NOT** apply closer than 30 days before harvest.
linuron LOROX DF (50 DF) AFOLAN F (480 g/L)	4.5 kg/ha 9 kg/ha 9.36 L/ha	 3.6 kg/ac 3.74 L/ac	• Apply as directed spray before weeds are 10 cm high. • Apply in 400–600 L/ha water (160–240 L/ac). • Add a surfactant. • Avoid contact with fruit, foliage or tree bark with spray or drift. • Use only under trees established at least 10 years.
paraquat GRAMOXONE (200 g/L)	1.1 kg/ha 5.5 L/ha	 2.2 L/ac	• Apply in 1100 L/ha (440 L/ac) water. • For spot spraying, apply 55 mL in 10 L of water sprayed to wet weed foliage. • Use on trees established 1 year or more. • Avoid contact with green bark, leaves or fruit. • May be used in mixtures with SINBAR, DEVRINOL or simazine.
paraquat GRAMOXONE (200 g/L) plus napropamide DEVRINOL DF (50 DF)	1.1 kg/ha 5.5 L/ha 4.5 kg/ha 9 kg/ha	 2.2 L/ac 3.6 kg/ac	• Add DEVRINOL to tank first then agitate and add GRAMOXONE. • Apply in 1100 L/ha water (440 L/ac). • Use on trees established 1 year or more. • Avoid contact with green bark, leaves or fruit.
paraquat GRAMOXONE (200 g/L) plus simazine PRINCEP NINE-T (90WG)	1.1 kg/ha 5.5 L/ha 2.25 to 4.5 kg/ha 2.5 to 5 kg/ha	 2.2 L/ac 1 to 2 kg/ac	• To control emerged weeds and provide residual control of germinating weeds. • Use on trees established 1 year or more. • Avoid contact with green bark, leaves or fruit. • See Precautions on GRAMOXONE and PRINCEP above.

* Various formulations available, see Table 1. See label for specific uses and rates.

Apricots

Site Preparation Before Planting — See Chapter 6, Special Methods of Weed Control

Recommended rates /ha or /ac refer to area actually treated with herbicide. Unless specified, apply all treatments in 150–300 L/ha (60–120 L/ac) water.

PREPLANT INCORPORATED (PPI) — Two incorporations at right angles operating at a depth of 10 cm using a double disk (7–10 km/hr) or vibrating shank S-tine cultivator (10–13 km/hr) are required unless otherwise stated. Cultivation-type equipment used for herbicide incorporation is known to spread perennial weeds to previously uninfested areas. Special attention should be directed toward machinery cleanliness, and/or treating fields with perennial weeds last.

PREEMERGENCE (PRE) — Rainfall at 15–20 mm within 7–10 days after application is necessary to activate preemergence treatments. Shallow cultivation, or harrowing will control weed escapes and improve herbicide activity in the absence of rainfall.

CAUTION — Simazine, DEVRINOL and SINBAR residues, high enough to harm many crops, may persist for several years after removal of orchard.

Apricots -- Year of Planting (Soil Applied Grass & Broadleaf Herbicides)

metribuzin LEXONE DF (75 DF)	0.38 to 0.75 kg/ha 0.5 to 1 kg/ha	 0.2 to 0.4 kg/ac	• PPI — Apply before planting trees in the year of planting. • Make single application as an orchard floor or planting row treatment.

metribuzin	0.42 to 0.56 kg/ha		▪ PPI — Apply and incorporate before planting trees.
SENCOR 75 DF (75 WG)	0.55 to 0.75 kg/ha	0.22 to 0.3 kg/ac	▪ Apply as an orchard floor or planting row treatment.
plus trifluralin	0.6 to 1.155 kg/ha		▪ Apply **ONCE** in the year of planting only.
TREFLAN EC (480 g/L)	1.25 to 2.4 L/ha	0.5 to 0.96 L/ac	
BONANZA 400 (400 g/L)	1.5 to 2.75 L/ha	0.6 to 1.1 L/ac	
napropamide	3.5 kg/ha		▪ PRE — Apply in the fall through early spring before weeds emerge.
DEVRINOL DF (50 DF)	7 kg/ha	2.8 kg/ac	▪ Incorporation by rainfall or irrigation is essential.
plus simazine	2 kg/ha		▪ **Do NOT** apply on frozen ground.
PRINCEP NINE-T (90WG)	2.25 kg/ha	0.9 kg/ac	▪ Make 1 application in the year of planting **ONLY**.
napropamide	4.5 kg/ha		▪ PRE — Apply in the fall through early spring before weeds emerge.
DEVRINOL 50W (50 WP)	9 kg/ha	3.6 kg/ac	▪ Incorporation by rainfall or irrigation is essential.
plus terbacil	0.5 kg/ha		▪ **Do NOT** apply on frozen ground.
SINBAR (80 WP)	0.63 kg/ha	0.25 kg/ac	▪ Make 1 application in the year of planting **ONLY**.
s-metolachlor	1.14 to 1.6 kg/ha		▪ PRE — Apply after planting, before weeds emerge, preferably after rain has settled the soil around the trees.
DUAL MAGNUM (915 g/L)	1.25 to 1.75 L/ha	0.5 to 0.7 L/ac	
plus simazine	1 to 2 kg/ha		▪ Apply once in the year of planting.
PRINCEP NINE-T (90WG)	1.1 to 2.2 kg/ha	0.44 to 0.88 kg/ac	▪ **Do NOT** use on sandy soils with less than 2% organic matter.
SIMAZINE 80W (80WP)	1.25 to 2.5 kg/ha	0.5 to 1 kg/ac	▪ Avoid contact with tree trunks and leaves.
simazine	1 to 2 kg/ha		▪ PRE — Apply after planting, before weeds emerge, preferably after rain has settled the soil around the trees.
PRINCEP NINE-T (90WG)	1.1 to 2.2 kg/ha	0.44 to 0.88 kg/ac	
SIMAZINE 80W (80WP)	1.25 to 2.5 kg/ha	0.5 to 1 kg/ac	▪ Apply once per season **ONLY**.
			▪ Avoid contact with trunk and leaves of trees.
			▪ **Do NOT** use on sandy soils with less than 2% organic matter.
trifluralin	0.6 to 1.155 kg/ha		▪ PPI — Apply and incorporate before planting trees.
TREFLAN EC (480 g/L)	1.25 to 2.4 L/ha	0.5 to 0.96 L/ac	▪ Use at least 100 L/ha water (40 L/ac).
BONANZA 400 (400 g/L)	1.5 to 2.75 L/ha	0.6 to 1.1 L/ac	▪ Apply once in the planting year **ONLY**.

Apricots — Year of Planting (Postemergence Grass Herbicides)

POSTEMERGENCE — Leaf stage of the weeds is critical for good weed control. Smaller weeds are generally easier to kill but there needs to be enough leaf surface to intercept the herbicide. Apply according to recommended leaf stages. Crop stage is important to optimize crop safety. Adjuvants will frequently improve the weed control when used as directed. Weather or other conditions may influence the optimum rate of adjuvant, see the product label for more details. Always use appropriate drift management technology.

sethoxydim	0.15 to 0.5 kg/ha		▪ Apply to actively growing grasses.
POAST ULTRA (450 g/L)	0.32 to 1.1 L/ha	0.13 to 0.45 L/ac	▪ For annual grass, use 0.32 L/ha. Apply at the 1–6 leaf stage.
plus surfactant/solvent			▪ For volunteer grains, use 0.47 L/ha.
MERGE	2 L/ha	0.8 L/ac	▪ For quackgrass, use 1.1 L/ha. Apply up to the 3–leaf stage.
			▪ **Do NOT** apply closer than 25 days to harvest.

Apricots — Year of Planting (Postemergence Broadleaf Herbicides)

bentazon	0.84 to 1.08 kg/ha		▪ Direct under trees to small actively growing weeds., avoiding tree leaves.
BASAGRAN (480 g/L)	1.75 to 2.25 L/ha	0.7 to 0.9 L/ac	▪ Apply in 100 to 400 L/ha water (40 to 160 L/ac) with at least 275 kPa pressure.
plus surfactant/solvent			▪ Use lower rate of MERGE under hot, humid conditions.
MERGE	1 to 2 L/ha	0.4 to 0.8 L/ac	▪ Make 2 applications, 10 days apart at 1.75 L/ha (0.7 L/ac) in the planting year **ONLY**.

Active Ingredient TRADE NAME (Formulation)	RATE (active) PRODUCT PER HA	RATE PRODUCT PER ACRE	PRECAUTIONS For more information, see Chapter 4 Notes on Herbicides and Chapter 5 Notes on Adjuvants
Apricots — Established Planting (Soil Applied Grass Herbicides)			
s-metolachlor DUAL MAGNUM (915 g/L)	1.6 kg/ha 1.75 L/ha	 0.7 L/ac	▪ PRE — Apply once per year as a band treatment under the trees before weeds emerge. ▪ Avoid contact with trunk and leaves of trees. ▪ **Do NOT** use on sandy soil with less than 2% organic matter.
Apricots — Established Planting (Soil Applied Broadleaf Herbicides)			
metribuzin LEXONE DF (75 DF)	0.75 kg/ha 1 kg/ha	 0.4 kg/ac	▪ PRE — Apply once per year as a band treatment under the trees before weeds emerge. ▪ Avoid contact with tree trunks and leaves.
Apricots — Established Planting (Soil Applied Grass & Broadleaf Herbicides)			
s-metolachlor DUAL MAGNUM (915 g/L) plus metribuzin LEXONE DF (75 DF)	1.6 kg/ha 1.75 L/ha 0.75 kg/ha 1 kg/ha	 0.7 L/ac 0.4 kg/ac	▪ PRE — Apply once per year as a band treatment under the trees before weeds emerge. ▪ Avoid contact with trunk and leaves of trees. ▪ **Do NOT** use on sandy soil with less than 2% organic matter.
s-metolachlor DUAL MAGNUM (915 g/L) plus simazine PRINCEP NINE-T (90WG)	1.6 kg/ha 1.75 L/ha 2.25 kg/ha 2.5 kg/ha	 0.7 L/ac 1 kg/ac	▪ PRE — Apply once per year as a band treatment under the trees before weeds emerge. ▪ Avoid contact with trunk and leaves of trees. ▪ **Do NOT** use on sandy soil with less than 2% organic matter. ▪ Late season crabgrass and fall panicum may escape this treatment.
terbacil SINBAR (80 WP) plus metribuzin LEXONE DF (75 DF)	0.5 kg/ha 0.63 kg/ha 0.75 kg/ha 1 kg/ha	 0.25 kg/ac 0.4 kg/ac	▪ PRE — Apply as a band under trees before weeds emerge. ▪ Use only 1 application per year. ▪ **Do NOT** use on soil coarser than sandy loams with less than 3% organic matter.
Apricots — Established Planting (Postemergence Grass Herbicides)			
POSTEMERGENCE — Leaf stage of the weeds is critical for good weed control. Smaller weeds are generally easier to kill but there needs to be enough leaf surface to intercept the herbicide. Apply according to recommended leaf stages. Crop stage is important to optimize crop safety. Adjuvants will frequently improve the weed control when used as directed. Weather or other conditions may influence the optimum rate of adjuvant, see the product label for more details. Always use appropriate drift management technology.			
fluazifop-p-butyl VENTURE L (125 g/L)	0.125 to 0.25 kg/ha 1 L to 2 L /ha	 0.4 to 0.8 L/ac	▪ Apply to actively growing grasses. ▪ For annual grasses, use 1 L/ha. Apply at the 2–6 leaf stage. ▪ For quackgrass, use 2 L/ha. Apply at the 3–5 leaf stage. ▪ **Do NOT** apply more than once per year. ▪ Grasses emerging after the treatment will not be controlled.
sethoxydim POAST ULTRA (450 g/L) plus surfactant/solvent MERGE	0.15 to 0.5 kg/ha 0.32 to 1.1 L/ha 1 to 2 L/ha	 0.13 to 0.45 L/ac 0.4 to 0.8 L/ac	▪ Apply to actively growing grasses. ▪ For annual grass, use 0.32 L/ha. Apply at the 1–6 leaf stage. ▪ For volunteer grains, use 0.47 L/ha. ▪ For quackgrass, use 1.1 L/ha. Apply up to the 3–leaf stage. ▪ **Do NOT** apply closer than 25 days to harvest.
Apricots — Established Planting (Postemergence Broadleaf Herbicides)			
2,4-D 2,4-D AMINE 600 (560 g/L)	0.952 kg/ha 1.7 L/ha	 0.68 L/ac	▪ For broadleaf weeds including dandelions, and seedling Canada thistle and sow-thistle. ▪ Apply in early spring after weeds emerge or postharvest to actively growing weeds. ▪ **Do NOT** apply when useable fruit is on the orchard floor. ▪ **Do NOT** closer than 80 days to harvest.

Apricots — Established Planting (Postemergence Grass & Broadleaf Herbicides)

glyphosate*
glyphosate (360 g/L)
 	
* Various formulations available, see Table 1. See label for specific uses and rates.
	0.81 to 4.32 kg/ha
	2.25 to 12 L/ha
		0.9 to 4.8 L/ac	▪ For actively growing weeds.
			▪ Apply in 200–300 L/ha water (80–120 L/ac) as a directed spray.
			▪ Remove all suckers from base of trunks before application.
			▪ **Do NOT** apply to trees with "green" bark in the area of application.
			▪ **Do NOT** mow or till weeds for at least 5–7 days after application. Wait longer if cool.
			▪ Only weeds emerged at application time will be controlled. Additional weed control programs will be necessary to control weeds germinating later.
			▪ Repeat application to regrowth may be necessary for complete control.
			▪ For **annual weeds**, use 2.25 to 3.5 L product/ha (0.9 to 1.4 L/ac).
			  ▪ Use 50–100 L/ha water (20–40 L/ac) for the low rate, or use a surfactant with larger water volumes.
			  ▪ Water volumes of 100–300 L/ha water (40–120 L/ac) can be used with the 3.5 L/ha rate.
			▪ For **dandelions and quackgrass**, use 2.5 to 7 L product /ha (1 to 2.8 L/ac).
			  ▪ Apply when plants have at least 3–4 new leaves.
			  ▪ The low rate (2.5 L/ha (1 L/ac)) will provide a minimum of 1 season control while higher rates (4.75 to 7 L/ha (1.9 to 2.8 L/ac)) will provide longer term control.
			  ▪ For dandelion control apply 2.5 L/ha (1 L/ac) if 15 cm or less in diameter and 3.5 to 5 L/ha (1.4 to 2 L/ac) if larger than 15 cm.
			▪ For **perennial broadleaf weeds**, use 7 to 12 L product/ha (2.8 to 4.8 L/ac)
			  ▪ Canada thistle and sow-thistle should be at least in early bud, milkweed at bud, bindweed at full flower, and dogbane past full bloom for best results.
			▪ **Do NOT** apply closer than 30 days to harvest.

glyphosate* glyphosate (360 g/L)	0.36 kg/2L 1 L/2L water (33% solution)		▪ Apply with a rope wick or other similar device when weeds are at the optimum stage. ▪ Avoid contact with the leaves, trucks and suckers. ▪ **Do NOT** apply when weeds are wet. ▪ See **Chapter 2, Selective Weed Control with Wiper Applicators.** ▪ **Do NOT** apply closer than 30 days to harvest.
glyphosate* glyphosate (360 g/L)	0.36 to 0.72 kg/100 L 1 to 2 L/100 L water (1 to 2% solution)		▪ Use hand held sprayers as a spot treatment if wiper equipment is not available. ▪ Avoid contact with leaves, trucks and suckers. ▪ **Do NOT** apply closer than 30 days before harvest.
paraquat GRAMOXONE (200 g/L)	1.1 kg/ha 5.5 L/ha	2.2 L/ac	▪ Apply in 1100 L/ha (440 L/ac) water. ▪ For spot spraying, apply 55 mL in 10 L of water sprayed to wet weed foliage. ▪ Use on trees established 1 year or more. ▪ Avoid contact with green bark, leaves or fruit.

* Various formulations available, see Table 1. See label for specific uses and rates.

Cherries & Plums

Site Preparation Before Planting — See Chapter 6, Special Methods of Weed Control

Recommended rates /ha or /ac refer to area actually treated with herbicide. Unless specified, apply all treatments in 150–300 L/ha (60–120 L/ac) water.

PREPLANT INCORPORATED (PPI) — Two incorporations at right angles operating at a depth of 10 cm using a double disk (7–10 km/hr) or vibrating shank S-tine cultivator (10–13 km/hr) are required unless otherwise stated. Cultivation-type equipment used for herbicide incorporation is known to spread perennial weeds to previously uninfested areas. Special attention should be directed toward machinery cleanliness, and/or treating fields with perennial weeds last.

PREEMERGENCE (PRE) — Rainfall at 15–20 mm within 7–10 days after application is necessary to activate preemergence treatments. Shallow cultivation, or harrowing will control weed escapes and improve herbicide activity in the absence of rainfall.

CAUTION — Simazine, DEVRINOL and SINBAR residues, high enough to harm many crops, may persist for several years after removal of orchard.

Cherries & Plums — Year of Planting (Soil Applied Grass & Broadleaf Herbicides)

TRADE NAME, Formulation	RATE (active) PRODUCT PER HA	RATE PRODUCT PER ACRE	PRECAUTIONS For more information see Chapter 4, Notes on Herbicides and Chapter 5, Notes on Adjuvants
dichlobenil CASORON 4G (4 Gr)	4.4 to 7 kg/ha 110 to 175 kg/ha	 44 to 70 kg/ac	• PRE — Apply to cool, moist soil in spring before weeds emerge or after cultivation. • **Do NOT** apply if air temps are above 10–15°C to avoid injury from volatilization. • **Do NOT** apply until 4 weeks after transplanting. • **Do NOT** use on light sandy soils. • 70 g of CASORON 4G applied to an area 2x2 m is equivalent to 175 kg/ha (70 kg/ac).
metribuzin LEXONE DF (75 DF)	0.38 to 0.75 kg/ha 0.5 to 1 kg/ha	 0.2 to 0.4 kg/ac	• PPI — Apply in the year of planting only. • Registered on cherries only. • Make a single application as a broadcast treatment or within the planting row.
metribuzin SENCOR 75 DF (75 WG) plus trifluralin TREFLAN EC (480 g/L) BONANZA 400 (400 g/L)	0.42 to 0.56 kg/ha 0.55 to 0.75 kg/ha 0.6 to 1.155 kg/ha 1.25 to 2.4 L/ha 1.5 to 2.75 L/ha	 0.22 to 0.3 kg/ac 0.5 to 0.96 L/ac 0.6 to 1.1 L/ac	• PPI — Apply and incorporate before planting trees. • Apply once in the year of planting **ONLY**.
napropamide DEVRINOL DF (50 DF) plus simazine PRINCEP NINE-T (90WG)	3.5 kg/ha 7 kg/ha 2 kg/ha 2.25 kg/ha	 2.8 kg/ac 0.9 kg/ac	• PRE — Apply in the fall through early spring before weeds emerge. • Incorporation by rainfall or irrigation is essential. • **Do NOT** apply on frozen ground. • Make 1 application in the planting year **ONLY**.
napropamide DEVRINOL DF (50 DF) plus terbacil SINBAR (80 WP)	4.5 kg/ha 9 kg/ha 0.5 kg/ha 0.63 kg/ha	 3.6 kg/ac 0.25 kg/ac	• PRE — Apply in the fall through early spring before weeds emerge. • Incorporation by rainfall or irrigation is essential. • **Do NOT** apply on frozen ground. • Make 1 application in the planting year **ONLY**.
s-metolachlor DUAL MAGNUM (915 g/L) plus simazine PRINCEP NINE-T (90WG) SIMAZINE 80W (80WP)	1.14 to 1.6 kg/ha 1.25 to 1.75 L/ha 1 to 2 kg/ha 1.1 to 2.2 kg/ha 1.25 to 2.5 kg/ha	 0.5 to 0.7 L/ac 0.44 to 0.88 kg/ac 0.5 to 1 kg/ac	• PRE — Apply after planting, before weeds emerge, preferably after rain has settled the soil around the trees. • Apply once in the year of planting. • **Do NOT** use on sandy soils with less than 2% organic matter. • Avoid contact with tree trunks and leaves.
terbacil SINBAR (80 WP)	1 kg/ha 1.25 kg/ha	 0.5 kg/ac	• PRE — Apply after planting trees, before weeds emerge. • **Do NOT** use on soils with less than 2% organic matter. • Avoid contact with tree trunks and leaves.

trifluralin	0.6 to 1.155 kg/ha		▪ PPI — Apply and incorporate before planting trees.
TREFLAN EC (480 g/L)	1.25 to 2.4 L/ha	0.5 to 0.96 L/ac	▪ Use at least 100 L/ha water (40 L/ac).
BONANZA 400 (400 g/L)	1.5 to 2.75 L/ha	0.6 to 1.1 L/ac	▪ Apply once in the planting year **ONLY**.

Cherries & Plums — Year of Planting (Postemergence Grass Herbicides)

POSTEMERGENCE — Leaf stage of the weeds is critical for good weed control. Smaller weeds are generally easier to kill but there needs to be enough leaf surface to intercept the herbicide. Apply according to recommended leaf stages. Crop stage is important to optimize crop safety. Adjuvants will frequently improve the weed control when used as directed. Weather or other conditions may influence the optimum rate of adjuvant, see the product label for more details. Always use appropriate drift management technology.

sethoxydim	0.15 to 0.5 kg/ha		▪ Apply to actively growing grasses.
POAST ULTRA (450 g/L)	0.32 to 1.1 L/ha	0.13 to 0.45 L/ac	▪ For annual grass, use 0.32 L/ha. Apply at the 1–6 leaf stage.
plus surfactant/solvent			▪ For volunteer grains, use 0.47 L/ha.
MERGE	1 to 2 L/ha	0.4 to 0.8 L/ac	▪ For quackgrass, use 1.1 L/ha. Apply up to the 3–leaf stage.
			▪ **Do NOT** apply closer than 25 days to harvest.

Cherries & Plums — Year of Planting (Postemergence Broadleaf Herbicides)

bentazon	0.84 to 1.08 kg/ha		▪ Registered on cherries only.
BASAGRAN (480 g/L)	1.75 to 2.25 L/ha	0.7 to 0.9 L/ac	▪ Direct under trees to small actively growing weeds.
plus oil concentrate			▪ Avoid tree leaves.
ASSIST	1 to 2 L/ha	0.4 to 0.8 L/ac	▪ Apply in 100–400 L/ha water (40–160 L/ac) with at least 275 kPa pressure.
			▪ Use lower rate of ASSIST under hot, humid conditions.
			▪ Make 2 applications, 10 days apart at 1.75 L/ha (0.7 L/ac) in the planting year.

Cherries & Plums — Established Planting (Soil Applied Grass Herbicides)

s-metolachlor	1.6 kg/ha		▪ PRE — Apply once per year as a band treatment under the trees before weeds emerge.
DUAL MAGNUM (915 g/L)	1.75 L/ha	0.7 L/ac	▪ Avoid contact with trunk and leaves of trees.
			▪ **Do NOT** use on sandy soil with less than 2% organic matter.

Cherries & Plums — Established Planting (Soil Applied Broadleaf Herbicides)

metribuzin	0.75 kg/ha		▪ PRE — Apply once per year as a band treatment under the trees before weeds emerge.
LEXONE DF (75 DF)	1 kg/ha	0.4 kg/ac	▪ Avoid contact with tree trunks and leaves.

Cherries & Plums — Established Planting (Soil Applied Grass & Broadleaf Herbicides)

dichlobenil	4.4 to 7 kg/ha		▪ PRE — Apply to cool moist but unfrozen soil in late fall or spring before weeds emerge.
CASORON 4G (4 Gr)	110 to 175 kg/ha	44 to 70 kg/ac	▪ **Do NOT** apply if air temps are above 10–15°C to avoid injury from volatilization.
			▪ **Do NOT** use on light sandy soils.
			▪ 70 g of CASORON 4G applied to an area 2x2 m is equivalent to 175 kg/ha (70 kg/ac).
linuron	4.5 kg/ha		▪ PRE — Apply as a directed spray before weeds are 10 cm high.
LOROX DF (50 DF)	9 kg/ha	3.6 kg/ac	▪ Apply in 400–600 L/ha water (160–240 L/ac).
AFOLAN F (480 g/L)	9.36 L/ha	3.74 L/ac	▪ Add a surfactant.
LINURON 480 (480 g/L)	9.36 L/ha	3.74 L/ac	▪ Use **ONLY** under trees established for 10 years.
			▪ Keep spray off fruit, leaves and green bark of trees.
s-metolachlor	1.6 kg/ha		▪ PRE — Apply once per year as a band treatment under the trees before weeds emerge.
DUAL MAGNUM (915 g/L)	1.75 L/ha	0.7 L/ac	▪ Avoid contact with trunk and leaves of trees.
plus metribuzin	0.75 kg/ha		▪ **Do NOT** use on sandy soil with less than 2% organic matter.
LEXONE DF (75 DF)	1 kg/ha	0.4 kg/ac	

Active ingredient TRADE NAME (Formulation)	RATE (active) PRODUCT PER HA	RATE PRODUCT PER ACRE	PRECAUTIONS For more information, see Chapter 4: Notes on Herbicides and Chapter 5: Notes on Adjuvants
s-metolachlor	1.6 kg/ha		▪ PRE — Apply once per year as a band treatment under the trees before weeds emerge.
DUAL MAGNUM (915 g/L)	1.75 L/ha	0.7 L/ac	▪ Avoid contact with trunk and leaves of trees.
plus simazine	2.25 kg/ha		▪ **Do NOT** use on sandy soil with less than 2% organic matter.
PRINCEP NINE-T (90WG)	2.5 kg/ha	1 kg/ac	▪ Late season crabgrass and fall panicum may escape this treatment.
terbacil	0.5 kg/ha		▪ PRE — Apply as a band under trees before weeds emerge.
SINBAR (80 WP)	0.63 kg/ha	0.25 kg/ac	▪ Registered on cherries only.
plus metribuzin	0.75 kg/ha		▪ Use only 1 application per year.
LEXONE DF (75 DF)	1 kg/ha	0.4 kg/ac	▪ **Do NOT** use on soil coarser than sandy loams with less than 3% organic matter.
Cherries & Plums — Established Planting (Postemergence Grass Herbicides)			
POSTEMERGENCE — Leaf stage of the weeds is critical for good weed control. Smaller weeds are generally easier to kill but there needs to be enough leaf surface to intercept the herbicide. Apply according to recommended leaf stages. Crop stage is important to optimize crop safety. Adjuvants will frequently improve the weed control when used as directed. Weather or other conditions may influence the optimum rate of adjuvant, see the product label for more details. Always use appropriate drift management technology.			
fluazifop-p-butyl	0.125 to 0.25 kg/ha		▪ Apply to actively growing grasses.
VENTURE L (125 g/L)	1 L to 2 L /ha	0.4 to 0.8 L/ac	▪ For annual grasses, use 1 L/ha. Apply at the 2–6 leaf stage. ▪ For quackgrass, use 2 L/ha. Apply at the 3–5 leaf stage. ▪ **Do NOT** apply more than once per year. ▪ Grasses emerging after the treatment will not be controlled.
sethoxydim	0.15 to 0.5 kg/ha		▪ Apply to actively growing grasses.
POAST ULTRA (450 g/L)	0.32 to 1.1 L/ha	0.13 to 0.45 L/ac	▪ For annual grass, use 0.32 L/ha. Apply at the 1–6 leaf stage.
plus surfactant/solvent			▪ For volunteer grains, use 0.47 L/ha.
MERGE	1 to 2 L/ha	0.4 to 0.8 L/ac	▪ For quackgrass, use 1.1 L/ha. Apply up to the 3–leaf stage. ▪ **Do NOT** apply closer than 25 days to harvest.
Cherries & Plums — Established Planting (Postemergence Broadleaf Herbicides)			
2,4-D	0.952 kg/ha		▪ For broadleaf weeds including dandelions, and seedling Canada thistle and sow-thistle.
2,4-D AMINE 600 (560 g/L)	1.7 L/ha	0.68 L/ac	▪ Apply in early spring after weeds emerge, or postharvest to actively growing weeds. ▪ **Do NOT** apply closer than 80 days to harvest. ▪ **Do NOT** apply when useable fruit is on the orchard floor.
Cherries & Plums — Established Planting (Postemergence Grass & Broadleaf Herbicides)			
glufosinate ammonium	0.405 to 0.75 kg/ha		▪ Registered on plums only.
IGNITE (150 g/L)	2.7 to 5 L/ha	1.08 to 2 L/ac	▪ Apply as a directed spray before weeds are 30 cm high. ▪ Use 110–330 L/ha water (44–132 L/ac). ▪ Where weed growth is heavy, use the higher rate and larger water volume. ▪ **Do NOT** apply closer than 40 days to harvest. ▪ For trees established at least 1 year.
glyphosate*	0.81 to 4.32 kg/ha		▪ For actively growing weeds.
glyphosate (360 g/L)	2.25 to 12 L/ha	0.9 to 4.8 L/ac	▪ Apply in 200–300 L/ha water (80–120 L/ac) as a directed spray. ▪ Remove all suckers from base of trunks before application. ▪ **Do NOT** apply to trees with "green" bark in the area of application. ▪ **Do NOT** mow or till weeds for at least 5–7 days after application. Wait longer if cool.

* Various formulations are available, see Table 1. See label for specific uses and rates.			▪ Only weeds emerged at application time will be controlled. Additional weed control programs will be necessary to control weeds germinating later.
			▪ Repeat application to regrowth may be necessary for complete control.
			▪ For **annual weeds**, use 2.25 to 3.5 L product/ha (0.9 to 1.4 L/ac).
			  ▪ Use 50–100 L/ha water (20–40 L/ac) for the low rate, or use a surfactant with larger water volumes.
			  ▪ Water volumes of 100–300 L/ha water (40–120 L/ac) can be used with the 3.5 L/ha rate.
			▪ For **dandelions and quackgrass**, use 2.5 to 7 L product /ha (1 to 2.8 L/ac).
			  ▪ Apply when plants have at least 3–4 new leaves.
			  ▪ The low rate (2.5 L/ha (1 L/ac)) will provide a minimum of 1 season control while higher rates (4.75 to 7 L/ha (1.9 to 2.8 L/ac)) will provide longer term control.
			  ▪ For dandelion control apply 2.5 L/ha (1 L/ac) if 15 cm or less in diameter and 3.5 to 5 L/ha (1.4 to 2 L/ac) if larger than 15 cm.
			▪ For **perennial broadleaf weeds**, use 7 to 12 L product/ha (2.8 to 4.8 L/ac)
			  ▪ Canada thistle and sow-thistle should be at least in early bud, milkweed at bud, bindweed at full flower, and dogbane past full bloom for best results.
			▪ **Do NOT** apply closer than 30 days to harvest.

glyphosate* glyphosate (360 g/L)	0.36 kg/2L 1 L/2L water (33% solution)		▪ Apply with a rope wick or other similar device when weeds are at the optimum stage. ▪ Avoid contact with the leaves, trucks and suckers. ▪ **Do NOT** apply when weeds are wet. ▪ See **Chapter 2, Selective Weed Control with Wiper Applicators.** ▪ **Do NOT** apply closer than 30 days to harvest.
glyphosate* glyphosate (360 g/L)	0.36 to 0.72 kg/100 L 1 to 2 L/100 L water (1 to 2% solution)		▪ Use hand held sprayers as a spot treatment if wiper equipment is not available ▪ Avoid contact with leaves, trucks and suckers. ▪ **Do NOT** apply closer than 30 days before harvest.
linuron LOROX DF (50 DF) AFOLAN F (480 g/L) LINURON 480 (480 g/L)	4.5 kg/ha 9 kg/ha 9.36 L/ha 9.36 L/ha	 3.6 kg/ac 3.74 L/ac 3.74 L/ac	▪ Apply as a directed spray before weeds are 10 cm high. ▪ Apply in 400–600 L/ha water (160–240 L/ac). ▪ Add a surfactant. ▪ Use only under trees established for 10 years. ▪ Keep spray off fruit, leaves and green bark of trees.
paraquat GRAMOXONE (200 g/L)	1.1 kg/ha 5.5 L/ha	 2.2 L/ac	▪ Apply in 1000 L/ha water (400 L/ac). ▪ For spot spraying, apply 55 mL in 10 L water sprayed to wet weed foliage. ▪ Use on trees established 1 year or more. ▪ Avoid contact with green bark, leaves or fruit. ▪ May be tank mixed with linuron for trees established at least 10 years.

* Various formulations available, see Table 1. See label for specific uses and rates.

Active ingredient TRADE NAME (Formulation)	RATE (active) PRODUCT PER HA	RATE PRODUCT PER ACRE	PRECAUTIONS For more information see Chapter 4 Notes on Herbicides and Chapter 5 Notes on Adjuvants

Grapes

[illegible] — See Chapter 5, Special Methods of Weed Control

Cultural Weed Control — See **CULTURAL WEED CONTROL IN FRUIT AND ORNAMENTAL CROPS**

Hilling the vines at regular intervals throughout the year will aid in weed control. Be aware that this disruption of the soil will also disturb any residual herbicides. The use of cultivation, mulch or rye cover crops between the rows will provide better water penetration as well as aid in weed control.

Grapes — Year of Planting

No herbicides are currently registered for new vineyard. Cultivation after planting is needed to level the soil, and early establishment on trellises or staked will minimize damage from cultivation. Hilling for winter protection can be started in late summer, and will control late germinating weeds. Removing of hills each spring will also aid in weed control.

Recommended rates /ha or /ac refer to area actually treated with herbicide. Unless specified, apply all treatments in 150–300 L/ha (60–120 L/ac) water.

PREEMERGENCE (PRE) — Rainfall at 15–20 mm within 7–10 days after application is necessary to activate preemergence treatments. Shallow cultivation, or harrowing will control weed escapes and improve herbicide activity in the absence of rainfall.

CAUTION — Simazine, KARMEX, DEVRINOL and SINBAR residues, high enough to harm many crops, may persist for several years after removal of vineyard.

[illegible] Grapevines — (Soil Applied Grass & Broadleaf Herbicides)

dichlobenil CASORON 4G (4 Gr)	4.4 to 9 kg/ha 110 to 225 kg/ha	 44 to 90 kg/ac	▪ PRE — Apply to cool moist but unfrozen soil in late fall or spring before weeds emerge. ▪ **Do NOT** apply if air temps are above 10–15°C to avoid injury from volatilization. ▪ Apply to dormant healthy vines **ONLY**. ▪ **Do NOT** apply to vines until they have been established for at least 2 full years. ▪ For annual weeds, use 110–175 kg/ha (44–70 kg/ac). ▪ For quackgrass, and broadleaf perennial weeds, use 175–225 kg/ha (70–90 kg/ac).
diuron KARMEX (80 DF)	1.8 to 5.36 kg/ha 2.25 to 6.7 kg/ha	 0.9 to 2.68 kg/ac	▪ PRE — Apply as a directed spray to a 1m strip under vines before weeds emerge. ▪ Apply in at least 300 L/ha water (120 L/ac). ▪ Use **ONLY** in vineyards established for at least 3 years. ▪ Use 2.25 kg/ha (0.9 kg/ac) in most vineyards. ▪ Use 4.5 kg/ha (1.8 kg/ac) where weed growth is heavy. ▪ Use 6.7 kg/ha (2.68 kg/ac) on heavy clay soils, or on high organic matter content soils. ▪ Apply in spring or fall or both, but **do NOT** exceed 4.5 kg/ha (1.8 kg/ac) in most soils. ▪ May be tank mixed with GRAMOXONE.
napropamide DEVRINOL 50W (50 WP)	4.5 kg/ha 9 kg/ha	 3.6 kg/ac	▪ PRE — Apply in the fall through early spring before weeds emerge. ▪ Use **ONLY** under vines that have been established at least 1 year. ▪ Incorporation by rainfall or irrigation is essential. ▪ **Do NOT** apply on frozen ground. ▪ Avoid contact with fruit and foliage.

simazine	3.6 to 4.5 kg/ha		▪ PRE — Apply after hills are removed, but before weed emerge.
PRINCEP NINE-T (90WG)	4 to 5 kg/ha	1.6 to 2 kg/ac	▪ Apply in at least 300 L/ha water (120 L/ac).
SIMADEX (500 g/L)	7.2 to 9 L/ha	2.9 to 3.6 L/ac	▪ Use higher rates on perennial weeds.
SIMAZINE 480 (480 g/L)	7.5 to 9.4 L/ha	3 to 3.76 L/ac	▪ Use **ONLY** in vineyards established for at least 3 years
			▪ May be tankmixed with IGNITE and glyphosate.

Established Grapevines: Postemergence Grass & Broadleaf Herbicides

POSTEMERGENCE — Leaf stage of the weeds is critical for good weed control. Smaller weeds are generally easier to kill but there needs to be enough leaf surface to intercept the herbicide. Apply according to recommended leaf stages. Crop stage is important to optimize crop safety. Always use appropriate drift management technology.

glufosinate ammonium	0.405 to 0.75 kg/ha		▪ For vines established at least 3 years.
IGNITE (150 g/L)	2.7 to 5 L/ha	1.08 to 2 L/ac	▪ Apply as a directed spray before annual weeds are 30 cm high.
			▪ Avoid suckers and green bark.
			▪ Use 110–330 L/ha water (44–132 L/ac).
			▪ Where weed growth is heavy, use the higher rate and larger water volume.
			▪ **Do NOT** apply closer than 40 days to harvest.
glufosinate ammonium	0.405 to 0.75 kg/ha		▪ For vines established at least 3 years.
IGNITE (150 g/L)	2.7 to 5 L/ha	1.08 to 2 L/ac	▪ Use as a directed spray avoiding leaves, suckers and green bark on vines.
plus simazine	3.6 to 4.5 kg/ha		▪ To control emerged weeds with residual control of germinating annual weeds.
PRINCEP NINE-T (90WG)	4 to 5 kg/ha	1.6 to 2 kg/ac	▪ See Precautions for IGNITE and simazine.
SIMADEX (500 g/L)	7.2 to 9 L/ha	2.88 to 3.6 L/ac	▪ **Do not** harvest until 40 days after application.
glyphosate*	0.81 to 4.32 kg/ha		▪ For actively growing weeds.
glyphosate (360 g/L)	2.25 to 12 L/ha	0.9 to 4.8 L/ac	▪ Apply in 200–300 L/ha water (80–120 L/ac) as a directed spray.
			▪ **Do NOT** use on vines less than 3 years old.
			▪ Direct spray to avoid leaves and green stems of grapevines.
			▪ **Do NOT** mow or till weeds for at least 5–7 days after application. Wait longer if cool.
			▪ Only weeds emerged at application time will be controlled. Additional weed control programs will be necessary to control weeds germinating later.
			▪ Repeat application to regrowth may be necessary for complete control.
			▪ For **annual weeds**, use 2.25 to 3.5 L product/ha (0.9 to 1.4 L/ac).
			▪ Use 50–100 L/ha water (20–40 L/ac) for the low rate, or use a surfactant with larger water volumes.
			▪ Water volumes of 100–300 L/ha water (40–120 L/ac) can be used with 3.5 L/ha.
			▪ For **dandelions and quackgrass**, use 2.5 to 7 L product /ha (1 to 2.8 L/ac).
			▪ Apply when plants have at least 3–4 new leaves.
			▪ The low rate (2.5 L/ha (1 L/ac)) will provide a minimum of 1 season control while higher rates (4.75 to 7 L/ha (1.9 to 2.8 L/ac)) will provide longer term control.
			▪ For dandelion control apply 2.5 L/ha (1 L/ac) if 15 cm or less in diameter and 3.5 to 5 L/ha (1.4 to 2 L/ac) if larger than 15 cm.
			▪ For **perennial broadleaf weeds**, use 7 to 12 L product/ha (2.8 to 4.8 L/ac)
			▪ Canada thistle and sow-thistle should be at least in early bud, milkweed at bud, bindweed at full flower, and dogbane past full bloom for best results.
			▪ **Do NOT** apply closer than 14 days to harvest.

* Various formulations are available, see Table 1. See label for specific uses and rates.

Active Ingredient TRADE NAME Formulation	RATE (active) PRODUCT PER HA	RATE PRODUCT PER ACRE	PRECAUTIONS For more information see Chapter 4 Notes on Herbicides and Chapter 5 Notes on Adjuvants
glyphosate* glyphosate (360 g/L)	0.36 kg/2L 1 L/2L water (33% solution)		▪ Apply with a rope wick or other similar device when weeds are at the optimum stage. ▪ Direct spray to avoid leaves and green stems of grapevines. ▪ **Do NOT** apply when weeds are wet. ▪ **Do NOT** use on vines less than 3 years. old ▪ See **Chapter 2, Selective Weed Control with Wiper Applicators.** ▪ **Do NOT** apply closer than 14 days to harvest.
glyphosate* glyphosate (360 g/L)	0.36 to 0.72 kg/100 L 1 to 2 L/100 L water (1 to 2% solution)		▪ Use hand held sprayers as a spot treatment if wiper equipment is not available. ▪ Direct spray to avoid leaves and green stems of grapevines. ▪ **Do NOT** use on vines less than 3 year old ▪ **Do NOT** apply closer than 14 days before harvest.
glyphosate* glyphosate (360 g/L) plus simazine PRINCEP NINE-T (90WG) SIMAZINE 80W (80WP)	0.81 to 4.32 kg/ha 2.25 to 12 L/ha 2.25 to 4.5 kg/ha 2.5 to 5 kg/ha 2.81 to 5.63 kg/ha	 0.9 to 4.8 L/ac 1 to 2 kg/ac 1.12 to 2.25 kg/ac	▪ For vines established at least 3 years. ▪ Use as a directed spray avoiding leaves, suckers and green bark on vines. ▪ Use higher rates for perennial weeds and heavy weed infestations. ▪ To control emerged weeds with residual control of germinating annual weeds. ▪ See Precautions for IGNITE and simazine. ▪ **Do not** use within 40 days of harvest.
paraquat GRAMOXONE (200 g/L)	1.1 kg/ha 5.5 L/ha	 2.2 L/ac	▪ Apply in 1100 L/ha (440 L/ac) water. ▪ For spot spraying, apply 55mL in 10 L of water sprayed to wet weed foliage. ▪ Use on vines established on trellises. ▪ Avoid contact with green bark, leaves or fruit. ▪ May be tankmixed with KARMEX.
paraquat GRAMOXONE (200 g/L) plus MCPB/MCPA (15:1) TROPOTOX PLUS (400 g/L)	1.1 kg/ha 5.5 L/ha 1.1 kg/ha 2.75 L/ha	 2.2 L/ac 1.1 L/ac	▪ Apply in late May or early June, or when bindweed starts to bloom. ▪ Apply in 1000 L/ha water (400 L/ac) as a low pressure, coarse spray. ▪ For spot spraying, with a shielded nozzle, apply 55mL GRAMOXONE + 30mL TROPOTOX PLUS/10 L water/100 m^2. ▪ Use only when necessary as a spot treatment. TROPOTOX PLUS can injure grapes. ▪ Direct spray to avoid contact with leaves and stems of grapevines.
paraquat GRAMOXONE (200 g/L) plus napropamide DEVRINOL 50W (50 WP)	1.1 kg/ha 5.5 L/ha 4.5 kg/ha 9 kg/ha	 2.2 L/ac 3.6 kg/ac	▪ Add DEVRINOL to tank first, then agitate and add GRAMOXONE. ▪ Apply in 1100 L/ha water (440 L/ac).

* Various formulations available, see Table 1. See label for specific uses and rates.

Peaches

Site Preparation Before Planting — See Chapter 6, Special Methods of Weed Control

Recommended rates /ha or /ac refer to area actually treated with herbicide. Unless specified, apply all treatments in 150–300 L/ha (60–120 L/ac) water.

PREPLANT INCORPORATED (PPI) —Two incorporations at right angles operating at a depth of 10 cm using a double disk (7–10 km/hr) or vibrating shank S-tine cultivator (10–13 km/hr) are required unless otherwise stated. Cultivation-type equipment used for herbicide incorporation is known to spread perennial weeds to previously uninfested areas. Special attention should be directed toward machinery cleanliness, and/or treating fields with perennial weeds last.

PREEMERGENCE (PRE) — Rainfall at 15–20 mm within 7–10 days after application is necessary to activate preemergence treatments. Shallow cultivation, or harrowing will control weed escapes and improve herbicide activity in the absence of rainfall.

CAUTION — Simazine, DEVRINOL and SINBAR residues, high enough to harm many crops, may persist for several years after removal of orchard.

Peaches — Year of Planting (Soil Applied Grass & Broadleaf Herbicides)

dichlobenil CASORON 4G (4 Gr)	4.4 to 7 kg/ha 110 to 175 kg/ha	 44 to 70 kg/ac	▪ PRE — Apply to cool, moist soil in spring before weeds emerge or after cultivation. ▪ **Do NOT** apply if air temps are above 10–15°C to avoid injury from volatilization. ▪ **Do NOT** apply until 4 weeks after transplanting. ▪ **Do NOT** use on light sandy soils. ▪ 70 g of CASORON 4G applied to an area 2x2 m is equivalent to 175 kg/ha (70 kg/ac).
metribuzin LEXONE DF (75 DF)	0.38 to 0.75 kg/ha 0.5 to 1 kg/ha	 0.2 to 0.4 kg/ac	▪ PPI — Apply and incorporate before planting trees. ▪ Make a single application as a broadcast treatment or within the planting row.
metribuzin SENCOR 75 DF (75 WG) plus trifluralin TREFLAN EC 480 g/L) BONANZA 400 (400 g/L)	0.42 to 0.56 kg/ha 0.55 to 0.75 kg/ha 0.6 to 1.155 kg/ha 1.25 to 2.4 L/ha 1.5 to 2.75 L/ha	 0.22 to 0.3 kg/ac 0.5 to 0.96 L/ac 0.6 to 1.1 L/ac	▪ PRE — Apply and incorporate before planting trees. ▪ Apply once in the year of planting **ONLY.** ▪ Apply as a broadcast treatment or within the planting row.
napropamide DEVRINOL DF (50 DF) plus simazine PRINCEP NINE-T (90WG)	3.5 kg/ha 7 kg/ha 2 kg/ha 2.25 kg/ha	 2.8 kg/ac 0.9 kg/ac	▪ PRE — Apply in the fall through early spring before weeds emerge. ▪ **Do NOT** apply on frozen ground or during harvest. ▪ Make 1 application in the planting year **ONLY.** ▪ Incorporation by rainfall or irrigation is essential within 2 days of application.
napropamide DEVRINOL DF (50 DF) plus terbacil SINBAR (80 WP)	4.5 kg/ha 9 kg/ha 0.5 kg/ha 0.63 kg/ha	 3.6 kg/ac 0.25 kg/ac	▪ PRE — Apply in the fall through early spring before weeds emerge. ▪ **Do NOT** apply on frozen ground or during harvest. ▪ Make 1 application in the planting year **ONLY.** ▪ Incorporation by rainfall or irrigation is essential within 2 days of application.
s-metolachlor DUAL MAGNUM (915 g/L) plus simazine PRINCEP NINE-T (90WG) SIMAZINE 80W (80WP)	1.14 to 1.6 kg/ha 1.25 to 1.75 L/ha 1 to 2 kg/ha 1.1 to 2.2 kg/ha 1.25 to 2.5 kg/ha	 0.5 to 0.7 L/ac 0.44 to 0.88 kg/ac 0.5 to 1 kg/ac	▪ PRE — Apply post planting, before weeds emerge, preferably after rain has settled the soil around the trees. ▪ Apply once in the year of planting. ▪ **Do NOT** use on sandy soils with less than 2% organic matter. ▪ Avoid contact with tree trunks and leaves.

Active Ingredient TRADE NAME (Formulation)	RATE (active) PRODUCT PER HA	RATE PRODUCT PER ACRE	PRECAUTIONS For more information, see Chapter 4, Notes on Herbicides and Chapter 5, Notes on Adjuvants
simazine PRINCEP NINE-T (90WG) SIMAZINE 80W (80WP)	1 to 2 kg/ha 1.1 to 2.2 kg/ha 1.25 to 2.5 kg/ha	 0.44 to 0.88 kg/ac 0.5 to 1 kg/ac	• PRE — Apply post planting, before weeds emerge, preferably after rain has settled the soil around the trees. • Apply once in the year of planting. • **Do NOT** use on sandy soils with less than 2% organic matter. • Avoid contact with tree trunks and leaves.
terbacil SINBAR (80 WP)	1 kg/ha 1.25 kg/ha	 0.5 kg/ac	• PRE — Apply after planting trees, before weeds emerge. • **Do NOT** use on soils with less than 2% organic matter. • Avoid contact with tree trunks and leaves.
trifluralin TREFLAN EC (480 g/L) BONANZA 400 (400 g/L)	0.6 to 1.155 kg/ha 1.25 to 2.4 L/ha 1.5 to 2.75 L/ha	 0.5 to 0.96 L/ac 0.6 to 1.1 L/ac	• PPI — Apply and incorporate before planting trees. • Use at least 100 L/ha water (40 L/ac). • Apply as a broadcast treatment or within the planting row. • Apply once in the year of planting **ONLY**.
Peaches — Year of Planting (Postemergence Grass Herbicides)			
POSTEMERGENCE — Leaf stage of the weeds is critical for good weed control. Smaller weeds are generally easier to kill but there needs to be enough leaf surface to intercept the herbicide. Apply according to recommended leaf stages. Crop stage is important to optimize crop safety. Adjuvants will frequently improve the weed control when used as directed. Weather or other conditions may influence the optimum rate of adjuvant, see the product label for more details. Always use appropriate drift management technology.			
sethoxydim POAST ULTRA (450 g/L) plus surfactant/solvent MERGE	0.15 to 0.5 kg/ha 0.32 to 1.1 L/ha 1 to 2 L/ha	 0.13 to 0.45 L/ac 0.4 to 0.8 L/ac	• Apply to actively growing grasses. • For annual grass, use 0.32 L/ha. Apply at the 1– 6 leaf stage. • For volunteer grains, use 0.47 L/ha. • For quackgrass, use 1.1 L/ha. Apply up to the 3–leaf stage. • **Do NOT** apply closer than 25 days to harvest.
Peaches — Year of Planting (Postemergence Broadleaf Herbicides)			
bentazon BASAGRAN (480 g/L) plus oil concentrate ASSIST	0.84 to 1.08 kg/ha 1.75 to 2.25 L/ha 1 to 2 L/ha	 0.7 to 0.9 L/ac 0.4 to 0.8 L/ac	• Direct under trees to small actively growing weeds. • Avoid tree leaves. • Apply in 100–400 L/ha water (40–160 L/ac) with at least 275 kPa pressure. • Use lower rate of ASSIST under hot, humid conditions. • Make 2 applications, 10 days apart at 1.75 L/ha (0.7 L/ac) in the planting year **ONLY**.
Peaches — Established Planting (Soil Applied Grass Herbicides)			
s-metolachlor DUAL MAGNUM (915 g/L)	1.6 kg/ha 1.75 L/ha	 0.7 L/ac	• PRE — Apply once per year as a band treatment under the trees before weeds emerge. • Avoid contact with trunk and leaves of trees. • **Do NOT** use on sandy soil with less than 2% organic matter.
Peaches — Established Planting (Soil Applied Broadleaf Herbicides)			
metribuzin LEXONE DF (75 DF)	0.75 kg/ha 1 kg/ha	 0.4 kg/ac	• PRE — Apply once per year as a band treatment under the trees before weeds emerge. • Avoid contact with tree trunks and leaves.
Peaches — Established Planting (Soil Applied Grass & Broadleaf Herbicides)			
dichlobenil CASORON 4G (4 Gr)	4.4 to 7 kg/ha 110 to 175 kg/ha	 44 to 70 kg/ac	• PRE — Apply to cool moist but unfrozen soil in late fall or spring before weeds emerge. • **Do NOT** apply if air temps are above 10–15°Cto avoid injury from volatilization. • **Do NOT** use on light sandy soils. • 70 g of CASORON 4G applied to an area 2x2 m is equivalent to 175 kg/ha (70 kg/ac).

linuron	4.5 kg/ha		• PRE — Apply in 400–600 L/ha water (160–240 L/ac) as a directed spray before weeds are 12 cm high. • Use only under peach trees established for over 1 year. • Keep spray off leaves, fruit and green bark of trees. • Add a surfactant.
LOROX DF (50 DF)	9 kg/ha	3.6 kg/ac	
AFOLAN F (480 g/L)	9.36 L/ha	3.74 L/ac	
LINURON 480 (480 g/L)	9.36 L/ha	3.74 L/ac	
napropamide	4.5 kg/ha		• PRE — Incorporation by rainfall or irrigation is essential. • Apply in the fall through early spring before weeds emerge, but not on frozen ground. • Avoid contact with fruit and foliage.
DEVRINOL 50W (50 WP)	9 kg/ha	3.6 kg/ac	
s-metolachlor	1.6 kg/ha		• PRE — Apply once per year as a band treatment under the trees before weeds emerge. • Avoid contact with trunk and leaves of trees. • **Do NOT** use on sandy soil with less than 2% organic matter.
DUAL MAGNUM (915 g/L)	1.75 L/ha	0.7 L/ac	
plus metribuzin	0.75 kg/ha		
LEXONE DF (75 DF)	1 kg/ha	0.4 kg/ac	
s-metolachlor	1.6 kg/ha		• PRE — Apply once per year as a band treatment under the trees before weeds emerge. • Avoid contact with trunk and leaves of trees. • **Do NOT** use on sandy soil with less than 2% organic matter. • Late season crabgrass and fall panicum may escape this treatment.
DUAL MAGNUM (915 g/L)	1.75 L/ha	0.7 L/ac	
plus simazine	2.25 kg/ha		
PRINCEP NINE-T (90WG)	2.5 kg/ha	1 kg/ac	
terbacil	1.8 to 3.6 kg/ha		• PRE — Apply in 1000 L/ha of water (400 L/ac). • Use only under trees established for at least 3 years. • Apply as a band under the trees before weeds emerge. • **Do NOT** use on soils with less than 3% organic matter.
SINBAR (80 WP)	2.25 to 4.5 kg/ha	0.9 to 1.8 kg/ac	
terbacil	0.5 kg/ha		• PRE — Apply as a band under trees before weeds emerge. • Use only 1 application per year. • **Do NOT** use on soil coarser than sandy loams with less than 3% organic matter.
SINBAR (80 WP)	0.63 kg/ha	0.25 kg/ac	
plus metribuzin	0.75 kg/ha		
LEXONE DF (75 DF)	1 kg/ha	0.4 kg/ac	

Peaches — Established Planting (Postemergence Grass Herbicides)

POSTEMERGENCE — Leaf stage of the weeds is critical for good weed control. Smaller weeds are generally easier to kill but there needs to be enough leaf surface to intercept the herbicide. Apply according to recommended leaf stages. Crop stage is important to optimize crop safety. Adjuvants will frequently improve the weed control when used as directed. Weather or other conditions may influence the optimum rate of adjuvant, see the product label for more details. Always use appropriate drift management technology.

fluazifop-p-butyl	0.125 to 0.25 kg/ha		• Apply to actively growing grasses. • For annual grasses, use 1 L/ha. Apply at the 2–6 leaf stage. • For quackgrass, use 2 L/ha. Apply at the 3–5 leaf stage. • **Do NOT** apply more than once per year. • Grasses emerging after the treatment will not be controlled.
VENTURE L (125 g/L)	1 L to 2 L /ha	0.4 to 0.8 L/ac	
sethoxydim	0.15 to 0.5 kg/ha		• Apply to actively growing grasses. • For annual grass, use 0.32 L/ha. Apply at the 1–6 leaf stage. • For volunteer grains, use 0.47 L/ha. • For quackgrass, use 1.1 L/ha. Apply up to the 3–leaf stage. • **Do NOT** apply closer than 25 days to harvest.
POAST ULTRA (450 g/L)	0.32 to 1.1 L/ha	0.13 to 0.45 L/ac	
plus surfactant/solvent			
MERGE	1 to 2 L/ha	0.4 to 0.8 L/ac	

Active ingredient TRADE NAME (Formulation)	RATE (active) PRODUCT PER HA	RATE PRODUCT PER ACRE	PRECAUTIONS For more information see Chapter 4 Notes on Herbicides and Chapter 5 Notes on Adjuvants
Peaches — Established Planting (Postemergence Broadleaf Herbicides)			
2,4-D 2,4-D AMINE 600 (560 g/L)	0.952 kg/ha 1.7 L/ha	0.68 L/ac	▪ To control broadleaf weeds, including dandelion, seedling Canada thistle and sow-thistle. ▪ Apply in early spring after weeds emerge or postharvest to actively growing weeds. ▪ **Do NOT** apply closer than 80 days to harvest. ▪ **Do NOT** apply when useable fruit is on the orchard floor.
Peaches — Established Planting (Postemergence Grass & Broadleaf Herbicides)			
glufosinate ammonium IGNITE (150 g/L)	0.405 to 0.75 kg/ha 2.7 to 5 L/ha	1.08 to 2 L/ac	▪ Apply as a directed spray before weeds are 30 cm high. ▪ Use 110–330 L/ha water (44–132 L/ac). ▪ Where weed growth is heavy, use the higher rate and larger water volume. ▪ **Do NOT** apply closer than 40 days to harvest. ▪ For trees established at least 1 year.

glyphosate*
glyphosate (360 g/L)
 	
* Various formulations are available, see Table 1. See label for specific uses and rates.
	0.81 to 4.32 kg/ha
	2.25 to 12 L/ha
		0.9 to 4.8 L/ac	▪ For actively growing weeds.
			▪ Apply in 200–300 L/ha water (80–120 L/ac) as a directed spray.
			▪ Remove all suckers from base of trunks before application.
			▪ **Do NOT** apply to trees with "green" bark in the area of application.
			▪ **Do NOT** mow or till weeds for at least 5–7 days after application. Wait longer if cool.
			▪ Only weeds emerged at application time will be controlled. Additional weed control programs will be necessary to control weeds germinating later.
			▪ Repeat application to regrowth may be necessary for complete control.
			▪ For **annual weeds**, use 2.25 to 3.5 L product/ha (0.9 to 1.4 L/ac).
			  ▪ Use 50–100 L/ha water (20–40 L/ac) for the low rate, or use a surfactant with larger water volumes.
			  ▪ Water volumes of 100–300 L/ha water (40–120 L/ac) can be used with 3.5 L/ha.
			▪ For **dandelions and quackgrass**, use 2.5 to 7 L product /ha (1 to 2.8 L/ac).
			  ▪ Apply when plants have at least 3–4 new leaves.
			  ▪ The low rate (2.5 L/ha (1 L/ac)) will provide a minimum of 1 season control while higher rates (4.75 to 7 L/ha (1.9 to 2.8 L/ac)) will provide longer term control.
			  ▪ For dandelion control apply 2.5 L/ha (1 L/ac) if 15 cm or less in diameter and 3.5 to 5 L/ha (1.4 to 2 L/ac) if larger than 15 cm.
			▪ For **perennial broadleaf weeds**, use 7 to 12 L product/ha (2.8 to 4.8 L/ac)
			  ▪ Canada thistle and sow-thistle should be at least in early bud, milkweed at bud, bindweed at full flower, and dogbane past full bloom for best results.
			▪ **Do NOT** apply closer than 30 days to harvest.

glyphosate* glyphosate (360 g/L)	0.36 kg/2L 1 L/2L water (33% solution)		▪ Apply with a rope wick or other similar device when weeds are at the optimum stage. ▪ Avoid contact with the leaves, trucks and suckers. ▪ **Do NOT** apply when weeds are wet. ▪ See **Chapter 2, Selective Weed Control with Wiper Applicators.** ▪ **Do NOT** apply closer than 30 days to harvest.

glyphosate* glyphosate (360 g/L)	0.36 to 0.72 kg/100 L 1 to 2 L/100 L water (1 to 2% solution)		▪ Use hand held sprayers as a spot treatment if wiper equipment is not available ▪ Avoid contact with leaves, trucks and suckers. ▪ **Do NOT** apply closer than 30 days before harvest.
linuron LOROX DF (50 DF) AFOLAN F (480 g/L)	4.5 kg/ha 9 kg/ha 9.36 L/ha	 3.6 kg/ac 3.74 L/ac	▪ Apply as directed spray before weeds are 10 cm high ▪ Apply in 400–600 L/ha water (160–240 L/ac). ▪ Add a surfactant. ▪ Avoid contact with fruit, foliage or tree bark with spray or drift. ▪ Use only under trees established at least 10 years
paraquat GRAMOXONE (200 g/L)	1.1 kg/ha 5.5 L/ha	 2.2 L/ac	▪ Apply in 1100 L/ha (440 L/ac) water. ▪ For spot spraying, apply 55 mL in 10 L of water sprayed to wet weed foliage. ▪ Use on trees established 1 year or more. ▪ Avoid contact with green bark, leaves or fruit. ▪ May be used in mixtures with DEVRINOL
paraquat GRAMOXONE (200 g/L) plus napropamide DEVRINOL DF (50 DF)	1.1 kg/ha 5.5 L/ha 4.5 kg/ha 9 kg/ha	 2.2 L/ac 3.6 kg/ac	▪ Add DEVRINOL to tank first then agitate and add GRAMOXONE. ▪ Apply in 1100 L/ha water (440 L/ac). ▪ Use on trees established 1 year or more. ▪ Avoid contact with green bark, leaves or fruit.

* Various formulations available, see Table 1. See label for specific uses and rates.

Pears

Site Preparation Before Planting — See Chapter 6, Special Methods of Weed Control

Recommended rates /ha or /ac refer to area actually treated with herbicide. Unless specified, apply all treatments in 150–300 L/ha (60–120 L/ac) water.

PREPLANT INCORPORATED (PPI) — Two incorporations at right angles operating at a depth of 10 cm using a double disk (7–10 km/hr) or vibrating shank S-tine cultivator (10–13 km/hr) are required unless otherwise stated. Cultivation-type equipment used for herbicide incorporation is known to spread perennial weeds to previously uninfested areas. Special attention should be directed toward machinery cleanliness, and/or treating fields with perennial weeds last.

PREEMERGENCE (PRE) — Rainfall at 15–20 mm within 7–10 days after application is necessary to activate preemergence treatments. Shallow cultivation, or harrowing will control weed escapes and improve herbicide activity in the absence of rainfall.

CAUTION — Simazine, DEVRINOL and SINBAR residues, high enough to harm many crops, may persist for several years after removal of orchard.

Pears — Year of Planting (Soil Applied Grass & Broadleaf Herbicides)

dichlobenil CASORON 4G (4 Gr)	4.4 to 7 kg/ha 110 to 175 kg/ha	 44 to 70 kg/ac	▪ PRE — Apply to cool, moist soil in spring before weeds emerge or after cultivation. ▪ **Do NOT** apply if air temps are above 10–15°C to avoid injury from volatilization. ▪ **Do NOT** apply until 4 weeks after transplanting. ▪ **Do NOT** use on light sandy soils. ▪ 70 g of CASORON 4G applied to an area 2x2 m is equivalent to 175 kg/ha (70 kg/ac).
metribuzin LEXONE DF (75 DF)	0.38 to 0.75 kg/ha 0.5 to 1 kg/ha	 0.2 to 0.4 kg/ac	▪ PPI before planting trees ▪ Make a single application as an orchard floor or planting row treatment.
metribuzin SENCOR 75 DF (75 WG) plus trifluralin TREFLAN EC (480 g/L) BONANZA 400 (400 g/L)	0.42 to 0.56 kg/ha 0.55 to 0.75 kg/ha 0.6 to 1.155 kg/ha 1.25 to 2.4 L/ha 1.5 to 2.75 L/ha	 0.22 to 0.3 kg/ac 0.5 to 0.96 L/ac 0.6 to 1.1 L/ac	▪ PPI before planting trees as an orchard floor or planting row treatment. ▪ Apply once in the planting year **ONLY**.

Active ingredient TRADE NAME (Formulation)	RATE (active) PRODUCT PER HA	RATE PRODUCT PER ACRE	PRECAUTIONS For more information see Chapter 4 Notes on Herbicides and Chapter 5 Notes on Adjuvants
napropamide	3.5 kg/ha		▪ PRE — Apply in the fall through early spring before weeds emerge.
DEVRINOL DF (50 DF)	7 kg/ha	2.8 kg/ac	▪ **Do NOT** apply on frozen ground or during harvest.
plus simazine	2 kg/ha		▪ Make **ONLY** 1 application in the planting year.
PRINCEP NINE-T (90WG)	2.25 kg/ha	0.9 kg/ac	▪ Incorporation by rainfall or irrigation is essential within 2 days of application.
napropamide	4.5 kg/ha		▪ PRE — Apply in the fall through early spring before weeds emerge.
DEVRINOL DF (50 DF)	9 kg/ha	3.6 kg/ac	▪ **Do NOT** apply on frozen ground or during harvest.
plus terbacil	0.5 kg/ha		▪ Make 1 application in the planting year **ONLY**.
SINBAR (80 WP)	0.63 kg/ha	0.25 kg/ac	▪ Incorporation by rainfall or irrigation is essential within 2 days of application.
s-metolachlor	1.14 to 1.6 kg/ha		▪ PRE — Apply post planting, before weeds emerge, preferably after rain has settled the soil around the trees.
DUAL MAGNUM (915 g/L)	1.25 to 1.75 L/ha	0.5 to 0.7 L/ac	
plus simazine	1 to 2 kg/ha		▪ Apply once in the year of planting.
PRINCEP NINE-T (90WG)	1.1 to 2.2 kg/ha	0.44 to 0.88 kg/ac	▪ **Do NOT** use on sandy soils with less than 2% organic matter.
SIMAZINE 80W (80WP)	1.25 to 2.5 kg/ha	0.5 to 1 kg/ac	▪ Avoid contact with tree trunks and leaves.
terbacil	1 kg/ha		▪ PRE — Apply after planting trees, before weeds emerge.
SINBAR (80 WP)	1.25 kg/ha	0.5 kg/ac	▪ **Do NOT** use on soils with less than 2% organic matter.
			▪ Avoid contact with tree trunks and leaves.
trifluralin	0.6 to 1.155 kg/ha		▪ PPI — Apply and incorporate before planting trees.
TREFLAN EC(480 g/L)	1.25 to 2.4 L/ha	0.5 to 0.96 L/ac	▪ Use at least 100 L/ha water (40 L/ac).
BONANZA 400 (400 g/L)	1.5 to 2.75 L/ha	0.6 to 1.1 L/ac	▪ Apply as a broadcast treatment or within the planting row.
			▪ Apply once in the year of planting **ONLY**.
Pears — Year of Planting (Postemergence Grass Herbicides)			
POSTEMERGENCE — Leaf stage of the weeds is critical for good weed control. Smaller weeds are generally easier to kill but there needs to be enough leaf surface to intercept the herbicide. Apply according to recommended leaf stages. Crop stage is important to optimize crop safety. Adjuvants will frequently improve the weed control when used as directed. Weather or other conditions may influence the optimum rate of adjuvant, see the product label for more details. Always use appropriate drift management technology.			
fluazifop-p-butyl	0.125 to 0.25 kg/ha		▪ Apply to actively growing grasses.
VENTURE L (125 g/L)	1 L to 2 L /ha	0.4 to 0.8 L/ac	▪ For annual grasses, use 1 L/ha. Apply at the 2–6 leaf stage.
			▪ For quackgrass, use 2 L/ha. Apply at the 3–5 leaf stage.
			▪ **Do NOT** apply more than once per year.
			▪ Grasses emerging after the treatment will not be controlled.
sethoxydim	0.15 to 0.5 kg/ha		▪ Apply to actively growing grasses.
POAST ULTRA (450 g/L)	0.32 to 1.1 L/ha	0.13 to 0.45 L/ac	▪ For annual grass, use 0.32 L/ha. Apply at the 1–6 leaf stage.
plus surfactant/solvent			▪ For volunteer grains, use 0.47 L/ha.
MERGE	1 to 2 L/ha	0.4 to 0.8 L/ac	▪ For quackgrass, use 1.1 L/ha. Apply up to the 3–leaf stage.
			▪ **Do NOT** apply closer than 25 days to harvest.
Pears — Year of Planting (Postemergence Broadleaf Herbicides)			
bentazon	0.84 to 1.08 kg/ha		▪ Direct under trees to small actively growing weeds.
BASAGRAN (480 g/L)	1.75 to 2.25 L/ha	0.7 to 0.9 L/ac	▪ Apply in 100–400 L/ha water (40–160 L/ac) with at least 275 kPa pressure.
plus oil concentrate			▪ Avoid tree leaves.
ASSIST	1 to 2 L/ha	0.4 to 0.8 L/ac	▪ Use lower rate of ASSIST under hot, humid conditions.
			▪ Make 2 applications, 10 days apart at the low rate, in the planting year **ONLY**.

Pears — Established Planting (Soil Applied Grass Herbicides)			
propyzamide KERB (50 WP)	2.25 kg/ha 4.5 kg/ha	 1.8 kg/ac	• PRE — Apply from late September to early November when soil is cool and moist but not frozen. • Use **ONLY** under apple trees established at least 1 year. • 4.5 kg/ha is equivalent to 45 g/100 m².
s-metolachlor DUAL MAGNUM (915 g/L)	1.6 kg/ha 1.75 L/ha	 0.7 L/ac	• PRE — Apply once per year as a band treatment under the trees before weeds emerge. • Avoid contact with trunk and leaves of trees. • **Do NOT** use on sandy soil with less than 2% organic matter.
Pears — Established Planting (Soil Applied Broadleaf Herbicides)			
metribuzin LEXONE DF (75 DF)	0.75 kg/ha 1 kg/ha	 0.4 kg/ac	• PRE — Apply once per year as a band treatment under the trees before weeds emerge. • Avoid contact with tree trunks and leaves.
Pears — Established Planting (Soil Applied Grass & Broadleaf Herbicides)			
dichlobenil CASORON 4G (4 Gr)	4.4 to 7 kg/ha 110 to 175 kg/ha	 44 to 70 kg/ac	• PRE — Apply to cool moist but unfrozen soil in late fall or spring before weeds emerge. • **Do NOT** apply if air temps are above 10–15°Cto avoid injury from volatilization. • **Do NOT** use on light sandy soils. • 70 g of CASORON 4G applied to an area 2x2 m is equivalent to 175 kg/ha (70 kg/ac).
linuron LOROX DF (50 DF) AFOLAN F (480 g/L) LINURON 480 (480 g/L)	4.5 kg/ha 9 kg/ha 9.36 L/ha 9.36 L/ha	 3.6 kg/ac 3.74 L/ac 3.74 L/ac	• PRE — Apply as directed spray before weeds are 10 cm high. • Apply in 400–600 L/ha water (160–240 L/ac). Add a surfactant. • Avoid contact with fruit, foliage or tree bark with spray or drift. • Use **ONLY** under trees established at least 10 years.
napropamide DEVRINOL DF (50 DF)	4.5 kg/ha 9 kg/ha	 3.6 kg/ac	• PRE — Apply in the fall through early spring before weeds emerge, but not on frozen ground. Avoid contact with fruit and foliage. • **Do NOT** apply when fruit is on the ground during harvest. • Incorporation by rainfall or irrigation is essential.
s-metolachlor DUAL MAGNUM (915 g/L) plus metribuzin LEXONE DF (75 DF)	1.6 kg/ha 1.75 L/ha 0.75 kg/ha 1 kg/ha	 0.7 L/ac 0.4 kg/ac	• PRE — Apply once per year as a band treatment under the trees before weeds emerge. • Avoid contact with trunk and leaves of trees. • **Do NOT** use on sandy soil with less than 2% organic matter.
s-metolachlor DUAL MAGNUM (915 g/L) plus simazine PRINCEP NINE-T (90WG)	1.6 kg/ha 1.75 L/ha 2.25 kg/ha 2.5 kg/ha	 0.7 L/ac 1 kg/ac	• PRE — Apply once per year as a band treatment under the trees before weeds emerge. • Avoid contact with trunk and leaves of trees. • **Do NOT** use on sandy soil with less than 2% organic matter. • Late season crabgrass and fall panicum may escape this treatment.
simazine PRINCEP NINE-T (90WG) SIMADEX (500 g/L) SIMAZINE 480 (480 g/L)	2.25 to 4.5 kg/ha 2.5 to 5 kg/ha 4.5 to 9 L/ha 4.7 to 9.4 L/ha	 1 to 2 kg/ac 1.8 to 3.6 L/ac 1.88 to 3.76 L/ac	• PRE — Apply in 300–1000 L/ha water (120–400 L/ac). • Use only under trees planted for 1 year or more. • Use higher rate on perennial weeds such as quackgrass. • May be combined with glyphosate.
terbacil SINBAR (80 WP) plus metribuzin LEXONE DF (75 DF)	0.5 kg/ha 0.63 kg/ha 0.75 kg/ha 1 kg/ha	 0.25 kg/ac 0.4 kg/ac	• PRE — Apply as a band under trees before weeds emerge. • Use only 1 application per year. • **Do NOT** use on soil coarser than sandy loams with less than 3% organic matter.

Active Ingredient TRADE NAME (Formulation)	RATE (active) PRODUCT PER HA	RATE PRODUCT PER ACRE	PRECAUTIONS For more information see Chapter 4 Notes on Herbicides and Chapter 5 Notes on Adjuvants
Pears — Established Planting (Postemergence Grass Herbicides)			
POSTEMERGENCE — Leaf stage of the weeds is critical for good weed control. Smaller weeds are generally easier to kill but there needs to be enough leaf surface to intercept the herbicide. Apply according to recommended leaf stages. Crop stage is important to optimize crop safety. Adjuvants will frequently improve the weed control when used as directed. Weather or other conditions may influence the optimum rate of adjuvant, see the product label for more details. Always use appropriate drift management technology.			
fluazifop-p-butyl VENTURE L (125 g/L)	0.125 to 0.25 kg/ha 1 L to 2 L /ha	 0.4 to 0.8 L/ac	• Apply to actively growing grasses. • For annual grasses, use 1 L/ha. Apply at the 2–6 leaf stage. • For quackgrass, use 2 L/ha. Apply at the 3–5 leaf stage. • **Do NOT** apply more than once per year. • Grasses emerging after the treatment will not be controlled.
sethoxydim POAST ULTRA (450 g/L) plus surfactant/solvent MERGE	0.15 to 0.5 kg/ha 0.32 to 1.1 L/ha 1 to 2 L/ha	 0.13 to 0.45 L/ac 0.4 to 0.8 L/ac	• Apply to actively growing grasses. • For annual grass, use 0.32 L/ha. Apply at the 1–6 leaf stage. • For volunteer grains, use 0.47 L/ha. • For quackgrass, use 1.1 L/ha. Apply up to the 3–leaf stage. • **Do NOT** apply closer than 25 days to harvest.
Pears — Established Planting (Postemergence Broadleaf Herbicides)			
2,4-D 2,4-D AMINE 600 (560 g/L)	0.952 kg/ha 1.7 L/ha	 0.68 L/ac	• To control broadleaf weeds, including dandelion, seedling Canada thistle and sow-thistle. • Apply in early spring after weeds emerge or postharvest to actively growing weeds. • **Do NOT** apply closer than 80 days to harvest. • **Do NOT** apply when useable fruit is on the orchard floor.
Pears — Established Planting (Postemergence Grass & Broadleaf Herbicides)			
glufosinate ammonium IGNITE (150 g/L)	0.405 to 0.705 kg/ha 2.7 to 5 L/ha	 1.08 to 2 L/ac	• Apply as a directed spray before weeds are 30 cm high. • Use 110–330 L/ha water (44–132 L/ac). • Where weed growth is heavy, use the higher rate and larger water volume. • **Do NOT** apply closer than 40 days to harvest. • For trees established at least 1 year.
glufosinate ammonium IGNITE (150 g/L) plus simazine PRINCEP NINE-T (90WG) SIMADEX (500 g/L)	0.405 to 0.75 kg/ha 2.7 to 5 L/ha 2.25 to 4.5 kg/ha 2.5 to 5 kg/ha 4.5 to 9 L/ha	 1.08 to 2 L/ac 1 to 2 kg/ac 1.8 to 3.6 L/ac	• To control emerged weeds plus residual control of annual grasses and broadleaf weeds. • Use as a directed spray around the bases of trees established at least 1 year. • **Do NOT** apply closer than 40 days to harvest. • See Precautions on IGNITE and PRINCEP.
glyphosate* glyphosate (360 g/L) * Various formulations are available, see Table 1. See label for specific uses and rates.	0.81 to 4.32 kg/ha 2.25 to 12 L/ha	 0.9 to 4.8 L/ac	• For actively growing weeds. • Apply in 200–300 L/ha water (80–120 L/ac) as a directed spray. • Remove all suckers from base of trunks before application. • **Do NOT** apply to trees with "green" bark in the area of application. • **Do NOT** mow or till weeds for at least 5–7 days after application. Wait longer if cool. • Only weeds emerged at application time will be controlled. Additional weed control programs will be necessary to control weeds germinating later. • Repeat application to regrowth may be necessary for complete control. • For **annual weeds**, use 2.25 to 3.5 L product/ha (0.9 to 1.4 L/ac).

			▪ Use 50–100 L/ha water (20–40 L/ac) for the low rate, or use a surfactant with larger water volumes. ▪ Water volumes of 100–300 L/ha water (40–120 L/ac) can be used with 3.5 L/ha. ▪ For **dandelions and quackgrass**, use 2.5 to 7 L product /ha (1 to 2.8 L/ac). ▪ Apply when plants have at least 3–4 new leaves. ▪ The low rate (2.5 L/ha (1 L/ac)) will provide a minimum of 1 season control while higher rates (4.75 to 7 L/ha (1.9 to 2.8 L/ac)) will provide longer term control. ▪ For dandelion control apply 2.5 L/ha (1 L/ac) if 15 cm or less in diameter and 3.5 to 5 L/ha (1.4 to 2 L/ac) if larger than 15 cm. ▪ For **perennial broadleaf weeds**, use 7 to 12 L product/ha (2.8 to 4.8 L/ac) ▪ Canada thistle and sow-thistle should be at least in early bud, milkweed at bud, bindweed at full flower, and dogbane past full bloom for best results. ▪ **Do NOT** apply closer than 30 days to harvest.
glyphosate* glyphosate (360 g/L)	0.36 kg/2L 1 L/2L water (33% solution)		▪ Apply with a rope wick or other similar device when weeds are at the optimum stage. ▪ Avoid contact with the leaves, trucks and suckers. ▪ **Do NOT** apply when weeds are wet. ▪ See **Chapter 2, Selective Weed Control with Wiper Applicators.** ▪ **Do NOT** apply closer than 30 days to harvest.
glyphosate* glyphosate (360 g/L)	0.36 to 0.72 kg/100 L 1 to 2 L/100 L water (1 to 2% solution)		▪ Use hand held sprayers as a spot treatment if wiper equipment is not available. ▪ Avoid contact with leaves, trucks and suckers. ▪ **Do NOT** apply closer than 30 days before harvest.
linuron LOROX DF (50 DF) AFOLAN F (480 g/L) LINURON 480 (480 g/L)	4.5 kg/ha 9 kg/ha 9.36 L/ha 9.36 L/ha	 3.6 kg/ac 3.74 L/ac 3.74 L/ac	▪ Apply as directed spray before weeds are 10 cm high. ▪ Apply in 400–600 L/ha water (160–240 L/ac). ▪ Add a surfactant. ▪ Avoid contact with fruit, foliage or tree bark with spray or drift. ▪ Use only under trees established at least 10 years.
paraquat GRAMOXONE (200 g/L)	1.1 kg/ha 5.5 L/ha	 2.2 L/ac	▪ Apply in 1100 L/ha (440 L/ac) water. ▪ For spot spraying, apply 55 mL in 10 L of water sprayed to wet weed foliage. ▪ Use on trees established 1 year or more. ▪ Avoid contact with green bark, leaves or fruit. ▪ May be used in mixtures with DEVRINOL or PRINCEP.
paraquat GRAMOXONE (200 g/L) plus napropamide DEVRINOL DF (50 DF)	1.1 kg/ha 5.5 L/ha 4.5 kg/ha 9 kg/ha	 2.2 L/ac 3.6 kg/ac	▪ Add DEVRINOL to tank first then agitate and add GRAMOXONE. ▪ Apply in 1100 L/ha water (440 L/ac). ▪ Use on trees established 1 year or more. ▪ Avoid contact with green bark, leaves or fruit.
paraquat GRAMOXONE (200 g/L) plus simazine PRINCEP NINE-T (90WG)	1.1 kg/ha 5.5 L/ha 2.25 to 4.5 kg/ha 2.5 to 5 kg/ha	 2.2 L/ac 1 to 2 kg/ac	▪ To control emerged weeds and provide residual control of germinating weeds. ▪ Use on trees established 1 year or more. ▪ Avoid contact with green bark, leaves or fruit. ▪ See Precautions on GRAMOXONE and PRINCEP above.

* Various formulations available, see Table 1. See label for specific uses and rates.

Notes:

Weed control ratings are given as 0-9 where 0 indicates no control and 9 indicates 90%-100% control under ideal conditions.

Ratings are subjective values based on best available information and give general comparisons based on use as descibed in this guide.

Under unfavorable conditions (eg., too dry, too wet, too cold, or poor application) the herbicides may not be as effective as indicated.

Ratings may vary with weed and crop stage and with the timing and rates of the product(s) being used.

Ratings in **BOLD** indicate the weed is listed on the product label for control or suppression.

Please see product label for more information on registered weed species, product uses and precautions.

TABLE 23. Fruit Crop Herbicide Weed Control Ratings

Trade Name	Crop Registrations										Annual Grasses						Annual Broadleaves						Perennial Weeds																				
	apples	apricots	blackberries	cherries/plums	currants/gooseberries	grapes	highbush blueberries	peaches	pears	raspberries	barnyard grass	crabgrass	fall panicum	foxtail	old witch grass	sandbur	chickweed, common	lady's-thumb	lamb's-quarters	mustards	pigweeds	ragweed	bindweed, field	chickweed, mouse-eared	dandelion	goldenrod	grape, wild	ground-ivy (creeping-charlie	mallow	milkweed	nightshade, climbing	nutsedge	plantains	poison-ivy	quackgrass	sow-thistle	stinging nettle	thistle, Canada	vetches	virginia creeper
CASORON	✓		✓	✓		✓	✓	✓	✓	✓	7	**6**	6	**6**	7	?	**8**	**7**	**8**	**3**	**8**	4	**7**	**7**	**7**	?	5	**6**	?	?	?	**7**	**7**	5	**7**	**7**	?	**7**	**7**	?
KARMEX						✓					9	**5**	5	**5**	8	?	9	9	**9**	9	**8**	**9**	?	?	5	?	?	?	?	5	?	5	?	?	5	5	?	5	?	?
LOROX, AFOLAN F, LINURON 480	✓			✓				✓	✓		7	**6**	5	**8**	9	?	9	**7**	**9**	7	**8**	**8**	5	8	?	?	?	?	?	5	?	8	?	?	7	8	?	7	?	?
DUAL MAGNUM	✓	✓		✓				✓	✓		**9**	**9**	**8**	**9**	**9**	?	6	2	7	2	**8**	4	0	?	5	?	?	?	?	0	?	**8**	5	?	0	0	0	0	0	0
LEXONE	✓	✓		✓[1]				✓			7	**8**	**9**	**8**	**9**	?	**9**	**9**	**9**	**9**	**8**	**8**	2	?	?	?	?	?	?	2	2	**2**	?	?	2	2	?	2	2	0
DEVRINOL	✓		✓			✓	✓	✓	✓	✓	**8**	**9**	**8**	**8**	8	**8**	7	6	**8**	5	**8**	7	?	?	5	?	?	?	?	5	?	5	5	1	5	5	?	5	1	?
KERB	✓								✓		**8**	**7**	**8**	**8**	**9**	8	**9**	7	9	8	9	7	?	?	?	?	?	?	?	6	?	6	?	?	**6**	6	?	?	?	?
PRINCEP NINE-T, SIMADEX, SIMAZINE 480	✓	✓	✓			✓	✓	✓	✓	✓	**8**	**8**	6	**8**	8	?	8	**9**	**9**	9	9	**8**	2	?	5	?	?	?	?	0	?	5	?	?	6	5	?	5	0	?
SINBAR	✓	✓[2]		✓[2]			✓	✓	✓[2]		**8**	**7**	8	**8**	8	5	**9**	7	**8**	**8**	7	7	6	8	6	?	?	?	?	6	?	6	8	?	6	1	?	6	1	?
TREFLAN	✓[2]	✓[2]		✓[2]				✓[2]	✓[2]		**9**	**9**	8	**8**	8	?	7	6	**8**	3	8	4	2	?	2	1	1	1	0	2	2	?	2	0	2	2	2	2	2	0
DUAL MAGNUM + LEXONE	✓	✓		✓				✓	✓		**9**	**9**	**9**	**9**	**9**	?	**9**	**9**	**9**	**9**	**8**	**8**	2	?	5	?	?	?	?	2	2	**8**	?	?	2	2	2	2	2	0
DUAL MAGNUM + PRINCEP NINE-T	✓	✓		✓				✓	✓		**9**	**9**	**9**	**9**	**9**	?	**9**	**9**	**9**	9	**8**	**8**	2	?	5	?	?	?	?	0	?	**8**	?	?	6	5	?	5	0	?
SENCOR + TREFLAN	✓[2]	✓[2]		✓[2]				✓[2]	✓[2]		**8**	**8**	**9**	**9**	**9**	?	**9**	**9**	**9**	**9**	**8**	**8**	2	?	2	1	1	1	0	2	2	**2**	2	0	2	2	2	2	2	0
DEVRINOL + PRINCEP NINE-T	✓[2]	✓[2]		✓[2]				✓[2]	✓[2]		**8**	**9**	**8**	**8**	8	**8**	7	**9**	**9**	9	**9**	**8**	2	?	5	2	2	2	2	5	2	5	5	1	6	5	2	5	1	0
DEVRINOL + SINBAR	✓[2]	✓[2]		✓[2]				✓[2]	✓[2]		**8**	**9**	**8**	**8**	8	**8**	**9**	7	**8**	**8**	**8**	7	6	?	6	2	2	2	2	6	2	6	8	1	6	5	2	6	1	0
SINBAR + LEXONE	✓	✓		✓[1]				✓	✓		**8**	**8**	**9**	**9**	**9**	?	**9**	**9**	**9**	**9**	**8**	**8**	?	8	6	2	2	2	2	6	2	6	8	2	6	2	2	6	2	0

Please see product label for more information on registered weed species, product uses and precautions.

TABLE 23. Fruit Crop Herbicide Weed Control Ratings

Trade Name	Crop Registrations										Annual Grasses						Annual Broadleaves						Perennial Weeds																					
	apples	apricots	blackberries	cherries/plums	currants/gooseberries	grapes	highbush blueberries	peaches	pears	raspberries	barnyard grass	crabgrass	fall panicum	foxtail	old witch grass	sandbur	chickweed, common	lady's-thumb	lamb's-quarters	mustards	pigweeds	ragweed	bindweed, field	chickweed, mouse-eared	dandelion	goldenrod	grape, wild	ground-ivy (creeping-charlie	mallow	milkweed	nightshade, climbing	nutsedge	plantains	poison-ivy	quackgrass	sow-thistle	stinging nettle	thistle, Canada	vetches	virginia creeper			
VENTURE L	✓	✓		✓			✓	✓	✓	✓	9	9	9	9	9	?	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	7	0	0	0	0	0			
POAST ULTRA	✓	✓		✓			✓	✓	✓	✓	8	8	9	8	9	?	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	0	0	0	0	0			
BASAGRAN	✓[2]	✓[2]		✓[1,2]				✓[2]	✓[2]		0	0	0	0	0	0	8	9	9	8	8	8	7	?	?	?	?	?	?	5	2	8	2	?	2	5	8[3]	6	5	?		
2,4-D*	✓	✓	✓	✓				✓	✓	✓	0	0	0	0	0	?	7	6	8	9	9	8	5	2	8	2	5	2	2	2	?	2	8	?	2	6	?	8	5	?		
AMITROL-T	✓										?	?	8	?	?	?	7	6	6	?	5	?	?	?	9	?	2	?	?	8	?	8	?	8	8	8	6	8	8	?		
IGNITE	✓			✓[5]		✓		✓	✓		9	9	9	9	9	?	9	9	9	8	9	9	8[3]	8[3]	8[3]	8[3]	8[3]	8[3]	8[3]	8[3]	8[3]	8[3]	8[3]	8[3]	5	9	8[3]	8[3]	8[3]	8[3]		
GLYPHOS, ROUNDUP, TOUCHDOWN	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	9	9	9	9	9	?	9	9	9	9	9	9	8	9	8/9[a]	?	8	5	5	9	?	5	9	9	9	9	5	9	5[3]	8[3]		
GRAMOXONE	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	9	9	9	9	9	?	9	9	9	9	9	9	8[3]	8[3]	8[3]	8[3]	8[3]	8[3]	8[3]	8[3]	8[3]	8[3]	8[3]	8[3]	8[3]	8[3]	8[3]	8[3]	8[3]	8[3]		
GRAMOXONE + DEVRINOL	✓					✓		✓	✓		9	9	9	9	9	?	9	9	9	9	9	9	8[3]	8[3]	8[3]	8[3]	8[3]	8[3]	8[3]	8[3]	8[3]	8[3]	8[3]	8[3]	8[3]	8[3]	8[3]	8[3]	8[3]	8[3]		

* Various formulations available, see Table 1.

Indicates crop registration.

[1] For Cherries only.

[2] Non-bearing trees only.

[3] For Plums only.

[a] Top growth only; regrowth can be expected.

[b] use higher rates when larger than 15 cm tall or across

CHAPTER 16. NURSERY & ORNAMENTAL CROPS

Herbaceous Ornamentals

Site Preparation Before Planting — See Chapter 6, Special Methods of Weed Control

To convert kg/ha or L/ha to g/ha or mL/100 m² — Multiply by 10 and change units to 100 m².

Example 11 kg/ha becomes 110 g/100 m²
28.4 L/ha becomes 284 mL/100 m².

PREPLANT INCORPORATED (PPI) — Two incorporations at right angles operating at a depth of 10 cm using a double disk (7–10 km/hr) or vibrating shank S-tine cultivator (10–13 km/hr) are required unless otherwise stated. Cultivation-type equipment used for herbicide incorporation is known to spread perennial weeds to previously uninfested areas. Special attention should be directed toward machinery cleanliness, and/or treating fields with perennial weeds last.

PREEMERGENCE (PRE) — Rainfall at 15–20 mm within 7–10 days after application is necessary to activate preemergence treatments. Shallow cultivation, rotary hoeing or harrowing will control weed escapes and improve herbicide activity in the absence of rainfall.

WARNING — Certain species may be injured by the following herbicides. Check manufacturer's directions for labeled species before use.

Active Ingredient TRADE NAME (Formulation)	RATE (active) PRODUCT PER HA	RATE PRODUCT PER ACRE	PRECAUTIONS (For more information, see "Notes on Chemicals" section.)
Herbaceous Ornamentals — Soil Applied Grass and Broadleaf Herbicides			
chlorpropham	5.577 kg/ha		▪ PRE — May be applied either PRE or POST to crop.
CIPC EC (480 g/L)	11.6 L/ha	4.64 L/ac	▪ Particularly effective against purslane.
CIPC (20 Gr)	27.5 kg/ha	11 kg/ac	▪ Apply after a clean cultivation, when the soil is moist, in 200–400 L/ha (80–160 L/ac) water.
trifluralin	0.6 to 1.155 kg/ha		▪ PPI — must be incorporated before transplanting.
TREFLAN EC(480 g/L)	1.25 to 2.4 L/ha	0.5 to 0.96 L/ac	▪ **Do NOT** use for seeded annuals.
RIVAL EC (500 g/L)	1.2 to 2.2 L/ha	0.48 to 0.94 L/ac	▪ Check label for list of tolerant species.
BONANZA 400 (400 g/L)	1.5 to 2.75 L/ha	0.6 to 1.1 L/ac	▪ Check label for application rate as it varies with soil type.
Herbaceous Ornamentals — Postemergent Grass Herbicides			
POSTEMERGENCE — Leaf stage of the weeds is critical for good weed control. Smaller weeds are generally easier to kill but there needs to be enough leaf surface to intercept the herbicide. Apply according to recommended leaf stages. Crop stage is important to optimize crop safety. Adjuvants will frequently improve the weed control when used as directed. Weather or other conditions may influence the optimum rate of adjuvant, see the product label for more details. Always use appropriate drift management technology.			
fluazifop-p-butyl	0.075 to 0.25 kg/ha		▪ For *Campanula* and *Sedum* — direct spray **ONLY** to avoid contact with crop.
VENTURE L (125 g/L)	0.6 to 2 L/ha	0.24 to 0.8 L/ac	▪ Apply to actively growing grasses prior to tillering. ▪ Apply at 0.6 L/ha (0.24 L/ac) at 2–5 leaf stage of annual grasses (2–4 leaf for foxtails). ▪ Apply at 0.8 L/ha (0.32 L/ac) at 2–5 leaf stage of volunteer wheat and barley. ▪ Apply at 2 L/ha (0.8 L/ac) at 3–5 leaf stage of quackgrass & wirestem muhly. ▪ Thorough preplant tillage, fragmenting quackgrass rhizomes improves control. ▪ Many species are tolerant in field production only. (Consult the label for list of tolerant species.)
Herbaceous Ornamentals — Postemergent Grass and Broadleaf Herbicides			
chlorpropham	5.577 kg/ha		▪ Apply as a directed spray or use the granular formulation.
CIPC EC (480 g/L)	11.6 L/ha	4.64 L/ac	▪ Particularly effective against purslane.
CIPC (20 Gr)	27.5 kg/ha	11 kg/ac	▪ Apply after a clean cultivation, when the soil is moist, in 200–400 L/ha (80–160 L/ac) water.

Shelterbelts (Windbreaks) Established

Cultural Weed Control — See **CULTURAL WEED CONTROL IN FRUIT AND ORNAMENTAL CROPS** section.

Site Preparation Before Planting — See Chapter 6, Special Methods of Weed Control

To convert kg/ha or L/ha to g/ha or mL/100 m² — Multiply by 10 and change units to 100 m².

Example 11 kg/ha becomes 110 g/100 m²
28.4 L/ha becomes 284 mL/100 m²

PREPLANT INCORPORATED (PPI) — Two incorporations at right angles operating at a depth of 10 cm using a double disk (7–10 km/hr) or vibrating shank S-tine cultivator (10–13 km/hr) are required unless otherwise stated. Cultivation-type equipment used for herbicide incorporation is known to spread perennial weeds to previously uninfested areas. Special attention should be directed toward machinery cleanliness, and/or treating fields with perennial weeds last.

PREEMERGENCE (PRE) — Rainfall of 15–20 mm within 7–10 days after application is necessary to activate preemergence treatments. Shallow cultivation, rotary hoeing or harrowing will control weed escapes and improve herbicide activity in the absence of rainfall.

WARNING — Certain species may be injured by the following herbicides. Check manufacturer's directions for labeled species before use.

Established Shelterbelts and Windbreaks — Soil Applied Grass and Broadleaf Herbicides

dichlobenil	4.4 to 7 kg/ha		▪ PRE — Apply in early spring or late fall.
CASORON 4G (4 Gr)	110 to 175 kg/ha	44 to 70 kg/ac	▪ Use the lower rate for spring application. ▪ Tolerant species include cedar, linden, maple, willow, caragana and ash. Reduce rates on lighter soils.
simazine	2.25 to 3.37 kg/ha		▪ PRE — Apply in 500 L/ha (200 L/ac) water.
PRINCEP NINE-T (90WG)	2.5 to 3.75 kg/ha	1 to 1.5 kg/ac	▪ Apply in the fall or spring prior to weed emergence or after emerged weeds have been removed.
SIMAZINE 480 (480 g/L)	4.7 to 7 L/ha	1.88 to 2.8 L/ac	▪ Windbreak species must be established for at least 1 year.
or simazine	1.8 to 6.75 kg/ha		▪ Tolerant species include cedar, spruce, black walnut, white ash, green ash, elm, boxelder, maple and caragana.
SIMADEX (500 g/L)	3.6 to 13.5 L/ha	1.44 to 5.4 L/ac	▪ Check label for species which will tolerate higher rates of simazine. Apply before buds break in spring.
or simazine	4.4 to 6.6 kg/ha		▪ Use low rate for sandy soils or low organic matter soils.
SIMAZINE 80W (80 WP)	5.5 to 8.25 kg/ha	2.2 to 3.3 kg/ac	
trifluralin	0.6 to 1.155 kg/ha		▪ PPI — Apply as a directed spray to the soil surface around the trees or shrubs.
TREFLAN EC(480 g/L)	1.25 to 2.4 L/ha	0.5 to 0.96 L/ac	▪ Incorporate as closely as possible to the trees and shrubs without causing damage to their roots.
BONANZA 400 (400 g/L)	1.5 to 2.75 L/ha	0.6 to 1.1 L/ac	

Established Shelterbelts and Windbreaks — Postemergent Grass Herbicides

POSTEMERGENCE — Leaf stage of the weeds is critical for good weed control. Smaller weeds are generally easier to kill but there needs to be enough leaf surface to intercept the herbicide. Apply according to recommended leaf stages. Crop stage is important to optimize crop safety. Adjuvants will frequently improve the weed control when used as directed. Weather or other conditions may influence the optimum rate of adjuvant, see the product label for more details. Always use appropriate drift management technology.

fluazifop-p-butyl	0.075 to 0.25 kg/ha		▪ Apply to actively growing grasses prior to tillering.
VENTURE L (125 g/L)	0.6 to 2 L/ha	0.24 to 0.8 L/ac	▪ Apply at 0.6 L/ha (0.24 L/ac) at 2–5 leaf stage of annual grasses (2–4 leaf for foxtails). ▪ Apply at 0.8 L/ha (0.32 L/ac) at 2–5 leaf stage of volunteer wheat and barley. ▪ Apply at 2 L/ha (0.8 L/ac) at 3–5 leaf stage of quackgrass & wirestem muhly. ▪ Thorough preplant tillage, fragmenting quackgrass rhizomes improves control. ▪ **Do NOT** cultivate between rows until 5 days after application.

Active Ingredient TRADE NAME (Formulation)	RATE (active) PRODUCT PER HA	RATE PRODUCT PER ACRE	PRECAUTIONS (For more information, see "Notes on Chemicals" section.)
Established Shelterbelts and Windbreaks — Postemergent Grass and Broadleaf Herbicides			
glyphosate* glyphosate (360 g/L) * Various formulations are available, see Table 1. See label for specific uses and rates.	0.27 to 4.32 kg/ha 0.75 to 12 L/ha	 0.3 to 4.8 L/ac	▪ For actively growing weeds in the fall, or spring prior to emergence of any crop. ▪ Allow 5–7 days translocation time after application before doing any tillage when conditions are good. If cool temperatures follow application, allow additional time for translocation to be completed before disturbing treated weeds. ▪ Only weeds emerged at application time will be controlled. Additional weed control programs will be necessary to control weeds germinating later. ▪ Repeat application to regrowth may be necessary for complete control. ▪ For **annual weeds**, use 0.75 to 3.5 L product/ha (0.3 to 1.4 L/ac). ▪ Use 50–100 L/ha water (20–40 L/ac) for the low rate, or use a surfactant with larger water volumes. ▪ Water volumes of 100–300 L/ha water (40–120 L/ac) can be used with the 3.5 L rate. ▪ For **dandelions and quackgrass**, use 2.5 to 7 L product /ha (1 to 2.8 L/ac). ▪ Apply when plants have at least 3–4 new leaves. ▪ The low rate (2.5 L/ha (1 L/ac)) will provide a minimum of 1 season control while higher rates (4.75 to 7 L/ha (1.9 to 2.8 L/ac)) will provide longer term control. ▪ For dandelion control apply 2.5 L/ha (1 L/ac) if 15 cm or less in diameter and 3.5 to 5 L/ha (1.4 to 2 L/ac) if larger than 15 cm. ▪ For **perennial broadleaf weeds**, use 7 to 12 L product/ha (2.8 to 4.8 L/ac). ▪ Canada thistle and sow-thistle should be at least in early bud, milkweed at bud, bindweed at full flower, and dogbane past full bloom for best results. ▪ For undisturbed perennials such as sod in non-crop areas, use the highest rate and repeat it when plants regrow to optimum stage.
paraquat GRAMOXONE (200 g/L)	1.1 kg/ha 5.5 L/ha	 2.2 L/ac	▪ Apply in 1000 L/ha (400 L/ac) water. ▪ For spot treatments, apply 55 mL/10 L water sprayed to wet weed foliage. ▪ Repeat treatment may be necessary during the season since there is no residual soil activity.
paraquat GRAMOXONE (200 g/L) plus simazine PRINCEP NINE-T (90WG)	1.1 kg/ha 5.5 L/ha 2.25 to 3.37 kg/ha 2.5 to 3.75 kg/ha	 2.2 L/ac 1 to 1.5 kg/ac	▪ This tank mix will provide knockdown of emerged weeds and residual control of germinating weeds. ▪ Use only on crops established for at least 1 year. ▪ See precautions on GRAMOXONE and simazine.

Shelterbelts (Windbreaks) Transplanted

Site Preparation Before Planting — See Chapter 5, Special Methods of Weed Control

PREPLANT INCORPORATED (PPI) — Two incorporations at right angles operating at a depth of 10 cm using a double disk (7–10 km/hr) or vibrating shank S-tine cultivator (10 to 13 km/hr) are required unless otherwise stated. Cultivation-type equipment used for herbicide incorporation is known to spread perennial weeds to previously uninfested areas. Special attention should be directed toward machinery cleanliness, and/or treating fields with perennial weeds last.

Transplanted Shelterbelts and Windbreaks — Soil Applied Grass and Broadleaf Herbicides

trifluralin	0.6 to 1.155 kg/ha		▪ PPI — Apply after a clean cultivation, and incorporate after application.
TREFLAN EC(480 g/L)	1.25 to 2.4 L/ha	0.5 to 0.96 L/ac	▪ Transplant the trees or shrubs so that most of their root system is placed below the treated layer of soil.
RIVAL EC (500 g/L)	1.2 to 2.2 L/ha	0.48 to 0.94 L/ac	
BONANZA 400 (400 g/L)	1.5 to 2.75 L/ha	0.6 to 1.1 L/ac	

Transplanted Shelterbelts and Windbreaks — Postemergent Grass Herbicides

POSTEMERGENCE — Leaf stage of the weeds is critical for good weed control. Smaller weeds are generally easier to kill but there needs to be enough leaf surface to intercept the herbicide. Apply according to recommended leaf stages. Crop stage is important to optimize crop safety. Adjuvants will frequently improve the weed control when used as directed. Weather or other conditions may influence the optimum rate of adjuvant, see the product label for more details. Always use appropriate drift management technology.

fluazifop-p-butyl	0.075 to 0.25 kg/ha		▪ Apply to actively growing grasses prior to tillering.
VENTURE L (125 g/L)	0.6 to 2 L/ha	0.24 to 0.8 L/ac	▪ Apply at 0.6 L/ha (0.24 L/ac) at 2–5 leaf stage of annual grasses (2–4 leaf for foxtails). ▪ Apply at 0.8 L/ha (0.32 L/ac) at 2–5 leaf stage of volunteer wheat and barley. ▪ Apply at 2 L/ha (0.8 L/ac) at 3 –5 leaf stage of quackgrass & wirestem muhly. ▪ Thorough preplant tillage, fragmenting quackgrass rhizomes improves control. ▪ **Do NOT** cultivate between rows until 5 days after application.

Woody Nursery Stock — Field Grown Nursery Stock

Cultural Weed Control — See **CULTURAL WEED CONTROL IN FRUIT AND ORNAMENTAL CROPS** section.

Mechanical weed control such as cultivation and hand hoeing will provide weed control in sensitive species as well as provide control of weed escapes. Cultivators are available which will work in between trees and in the row.

Site Preparation Before Planting — See Chapter 5, Special Methods of Weed Control

PREPLANT INCORPORATED (PPI) — Two incorporations at right angles operating at a depth of 10 cm using a double disk (7–10 km/hr) or vibrating shank S-tine cultivator (10–13 km/hr) are required unless otherwise stated. Cultivation-type equipment used for herbicide incorporation is known to spread perennial weeds to previously uninfested areas. Special attention should be directed toward machinery cleanliness, and/or treating fields with perennial weeds last.

PREEMERGENCE (PRE) — Rainfall at 15–20 mm within 7–10 days after application is necessary to activate preemergence treatments. Shallow cultivation, rotary hoeing or harrowing will control weed escapes and improve herbicide activity in the absence of rainfall.

WARNING — Refer to manufacturers' instructions for waiting period required after planting.

WARNING: Certain types of woody nursery stock may be injured by the following herbicides. Check manufacturer's directions for labeled species/cultivars before use.

Woody Nursery Stock (Field Grown) — Soil Applied Grass Herbicides

propyzamide	1.5 kg/ha		▪ PRE — Apply in the late fall when the soil temperature is low but above freezing.
KERB (50 WP)	3 kg/ha	1.2 kg/ac	▪ Soil moisture should be high. ▪ This herbicide is absorbed through the roots.

Active ingredient (TRADE NAME (Formulation)	RATE (active) PRODUCT PER HA	RATE PRODUCT PER ACRE	PRECAUTIONS (For more information see "Notes on Chemicals" section)
s-metolachlor DUAL MAGNUM (915 g/L)	1.14 to 1.6 kg/ha 1.25 to 1.75 L/ha	 0.5 to 0.7 L/ac	• PRE — Apply in at least 150 L of water. • Apply to soil prior to bud break of nursery stock. • **Do NOT** apply within 4 weeks of bud burst or until the needles have hardened. • For use on white spruce, Norway spruce, black spruce, white pine, Jack pine and red pine seedlings in their second year or older. • Also for use on poplar stoolbeds. • May have postemergent properties if applied to weeds before they reach the 2-leaf stage.
Woody Nursery Stock (Field Grown) — Soil Applied Broadleaf Herbicides			
isoxaben GALLERY (75 DF)	0.75 kg/ha 1 kg/ha	 0.4 kg/ac	• PRE — For use in bareroot and container conifer seedlings. • Applied prior to weed emergence in conifers, four or more weeds after crop germination and emergence. • Rainfall or irrigation is needed to activate the herbicide. • For use only by members of the Canadian Forest Nursery Weed Management Association.
Woody Nursery Stock (Field Grown) — Soil Applied Grass and Broadleaf Herbicides			
chlorpropham CIPC (20 Gr)	6.8 to 11 kg/ha 34 to 55 kg/ha	 13.6 to 22 kg/ac	• PRE — Apply the granular formulation after a clean cultivation when the soil is moist. • CIPC should not be used on tree fruit nursery stock.
dichlobenil CASORON 4G (4 Gr)	4.4 to 7 kg/ha 110 to 175 kg/ha	 44 to 70 kg/ac	• PRE — Apply in late fall or early spring. • Use lower rate for spring application. • **Do NOT** apply until 4 weeks after transplanting second year stock. • Reduce rate on lighter soil.
napropamide DEVRINOL 50W (50 WP) DEVRINOL DF (50 DF) DEVRINOL 10G (10 Gr)	4.5 kg/ha 9 kg/ha 9 kg/ha 45 kg/ha	 3.6 kg/ac 3.6 kg/ac 18 kg/ac	• PPI — Apply any time of the year to a clean cultivated soil surface or before weeds germinate. • Use only once prior to or during a growing season. • DEVRINOL must reach the zone of weed germination, either by mechanical incorporation or by adequate irrigation or precipitation. • Shallow incorporation to a chemical depth of 2.5–5.0 cm or an irrigation with sufficient water to wet the soil to depth of 5–10 cm should occur within 7 days of a spring or fall application and within 2 days of a summer application. • Fall applications will control weeds the following spring and summer. • **Caution** — Residues high enough to harm many crops may persist after repeated applications in perennial crops.
napropamide DEVRINOL 50W (50 WP) DEVRINOL DF (50 DF) plus simazine SIMAZINE 80W (80 WP)	4.5 kg/ha 9 kg/ha 9 kg/ha 1.1 kg/ha 1.37 kg/ha	 3.6 kg/ac 3.6 kg/ac 0.55 kg/ac	• PPI — Apply before weeds emerge on established plantings only. • Will provide additional control of broadleaf weeds. • See Precautions under DEVRINOL and simazine.

simazine	2.25 to 3.4 kg/ha		• PRE — Apply before weeds emerge on established plantings only. • **Do NOT** replant nursery stock into treated soil after stock is removed. • **Do NOT** use around ornamental shrubs if ground cover or bedding plants will be planted. • **Caution** — Residues high enough to harm many crops may persist after repeated applications.
PRINCEP NINE-T (90WG)	2.5 to 3.75 kg/ha	1 to 1.5 kg/ac	
or simazine	2.2 to 3.4 kg/ha		
SIMAZINE 80W (80 WP)	2.75 to 4.25 kg/ha	1.1 to 1.7 kg/ac	
or simazine	1.8 to 6.75 kg/ha		
SIMADEX (500 g/L)	3.6 to 13.5 L/ha	1.44 to 5.4 L/ac	
trifluralin	0.6 to 1.155 kg/ha		• PPI — Must be incorporated immediately after application, after a clean cultivation. • This treatment does not control ragweed, annual nightshade or mustards. • Lady's-thumb may also escape the treatment.
TREFLAN EC (480 g/L)	1.25 to 2.4 L/ha	0.5 to 0.96 L/ac	
RIVAL EC (60 DF)	1 to 1.9 kg/ha	0.4 to 0.76 kg/ac	

Woody Nursery Stock (Field Grown) — Postemergent Grass Herbicides

POSTEMERGENCE — Leaf stage of the weeds is critical for good weed control. Smaller weeds are generally easier to kill but there needs to be enough leaf surface to intercept the herbicide. Apply according to recommended leaf stages. Crop stage is important to optimize crop safety. Adjuvants will frequently improve the weed control when used as directed. Weather or other conditions may influence the optimum rate of adjuvant, see the product label for more details. Always use appropriate drift management technology.

fluazifop-p-butyl	0.075 to 0.25 kg/ha		• Apply to actively growing grasses prior to tillering. • Apply at 0.6 L/ha (0.24 L/ac) at 2–5 leaf stage of annual grasses (2–4 leaf for foxtails). • Apply at 0.8 L/ha (0.32 L/ac) at 2 –5 leaf stage of volunteer wheat and barley. • Apply at 2 L/ha (0.8 L/ac) at 3–5 leaf stage of quackgrass & wirestem muhly. • Thorough preplant tillage, fragmenting quackgrass rhizomes improves control. • **Do NOT** cultivate between rows until 5 days after application. • Consult the label for list of tolerant and sensitive species. Use as a directed application in sensitive species to avoid contact with leaves and green tissue. Some blue junipers (e.g. 'Bar Harbour', 'Blue Acres', and 'Blue Rug') can be injured by over-the-top applications. • **Caution;** there are differences between cultivars in sensitivity to FUSILADE, e.g. *Juniperus horizontalis* 'Blue Acres' is sensitive while *Juniperus horizontalis* 'Plumosa Compacta' is tolerant. • Test on samples of each cultivar not specifically listed on the label before using the herbicide or use as a directed application.
VENTURE L (125 g/L)	0.6 to 2 L/ha	0.24 to 0.8 L/ac	

Active ingredient TRADE NAME (Formulation)	RATE (active) PRODUCT PER HA	RATE PRODUCT PER ACRE	PRECAUTIONS (For more information see "Notes on Chemicals" section)
Woody Nursery Stock (Field Grown) — Postemergent Grass and Broadleaf Herbicides			
glyphosate* glyphosate (360 g/L) * Various formulations are available, see Table 1. See label for specific uses and rates.	0.27 to 4.32 kg/ha 0.75 to 12 L/ha	 0.3 to 4.8 L/ac	▪ For actively growing weeds in the fall, or spring prior to emergence of any crop. ▪ Allow 5–7 days translocation time after application before doing any tillage when conditions are good. If cool temperatures follow application, allow additional time for translocation to be completed before disturbing treated weeds. ▪ Only weeds emerged at application time will be controlled. Additional weed control programs will be necessary to control weeds germinating later. ▪ Repeat application to regrowth may be necessary for complete control. ▪ For **annual weeds**, use 0.75 to 3.5 L product/ha (0.3 to 1.4 L/ac). ▪ Use 50–100 L/ha water (20–40 L/ac) for the low rate, or use a surfactant with larger water volumes. ▪ Water volumes of 100–300 L/ha water (40–120 L/ac) can be used with the 3.5 L/ha rate. ▪ For **dandelions and quackgrass**, use 2.5 to 7 L product /ha (1 to 2.8 L/ac). ▪ Apply when plants have at least 3–4 new leaves. ▪ The low rate (2.5 L/ha (1 L/ac)) will provide a minimum of 1 season control while higher rates (4.75 to 7 L/ha (1.9 to 2.8 L/ac)) will provide longer term control. ▪ For dandelion control apply 2.5 L/ha (1 L/ac) if 15 cm or less in diameter and 3.5 to 5 L/ha (1.4 to 2 L/ac) if larger than 15 cm. ▪ For **perennial broadleaf weeds**, use 7 to 12 L product/ha (2.8 to 4.8 L/ac) ▪ Canada thistle and sow-thistle should be at least in early bud, milkweed at bud, bindweed at full flower, and dogbane past full bloom for best results. ▪ For undisturbed perennials such as sod in non-crop areas, use the highest rate and repeat it when plants regrow to optimum stage.
paraquat GRAMOXONE (200 g/L)	1.1 kg/ha 5.5 L/ha	 2.2 L/ac	▪ Use as a chemical mower. ▪ Can be used several times during the year. ▪ Direct spray to avoid the leaves or green bark of nursery plants. ▪ For spot treatments use 25 mL product in 4 L water.

Woody Nursery Stock — Container Beds

CULTURAL WEED CONTROL — A successful weed control program must integrate cultural and chemical weed control practices.
Prepare the container bed area with a gravel layer and/or ground covers such as black plastic or opaque woven material. It is important that these surface covers exclude light in order to be effective in preventing weed seed germination. These ground covers can be used for a number of years before being replaced.

Keep the container beds and roadways free of weeds by physical removal or chemical mowing. Prevent weeds from setting seed in adjacent uncropped areas by using cultural or chemical weed control measures. Mowing at regular intervals will prevent many weeds from flowering. Try to control weed escapes before they set seed by cultural removal or chemical mowing. In some situations, such as along fences, tools such as a weed whip may be useful. Look for the source of weeds that disseminate into container areas such as poplars, willows, willowherb and Canada fleabane.

Control weeds around irrigation ponds so that small seeded weeds are not being sown into container stock with each watering. A vigorous grassed bank will help reduce weed infestations as well as providing bank stabilization. A filtering system in the irrigation line will remove weed seeds.

Removal of existing weeds from container stock before they flower **must be a priority job**. Once a weed flowers it can disseminate hundreds of seeds by wind or by catapulting seeds. Many container weed species have several generations per year because their seeds do not need to overwinter before germinating. Remove and discard all pulled weeds well away from the growing area so that seeds are not disseminated into nearby containers.

Since many species of container weeds overwinter in the protected environment of a polyhouse, it is important to thoroughly weed container stock in the fall. Be sure to remove the rosettes of winter annuals such as shepherd's-purse and Canada fleabane and established plants and seedlings of common and mouse-eared chickweed. If not removed, these plants will be flowering by May or earlier.

PREEMERGENCE (PRE) — Rainfall at 15–20 mm within 7–10 days after application is necessary to activate preemergence treatments. Shallow cultivation, rotary hoeing or harrowing will control weed escapes and improve herbicide activity in the absence of rainfall.
WARNING — Refer to manufacturers' instructions for waiting period required after planting.
WARNING: Certain types of woody nursery stock may be injured by the following herbicides. Check manufacturer's directions for labeled species/cultivars before use.

Container Bed Preparation — Soil Applied Grass and Broadleaf Herbicides

dichlobenil	4.4 to 7 kg/ha		▪ PRE — Apply to bare soil before putting container pots on beds.
CASORON 4G (4 Gr)	110 to 175 kg/ha	44 to 70 kg/ac	▪ Apply in spring when temperatures are cool and incorporate immediately with irrigation or mechanical incorporation. ▪ For the best results, apply to soil with more than 2% organic matter content. ▪ Use on gravel or sandy soils may result in inconsistent weed control. ▪ **Do NOT** cover polyhouses with plastic within 1 month after application. ▪ **Do NOT** apply within plastic covered polyhouses or within greenhouse structures. ▪ Refer to label for tolerant species. ▪ **Do NOT** transplant into treated soil for 1 year.

Container Bed Preparation — Postemergent Grass and Broadleaf Herbicides

POSTEMERGENCE — Leaf stage of the weeds is critical for good weed control. Smaller weeds are generally easier to kill but there needs to be enough leaf surface to intercept the herbicide. Apply according to recommended leaf stages. Crop stage is important to optimize crop safety. Adjuvants will frequently improve the weed control when used as directed. Weather or other conditions may influence the optimum rate of adjuvant, see the product label for more details. Always use appropriate drift management technology.

Active ingredient TRADE NAME Formulation	RATE (active) PRODUCT PER HA	RATE PRODUCT PER ACRE	PRECAUTIONS (For more information see "Notes on Chemicals" section)

glyphosate*	0.27 to 4.32 kg/ha		• For actively growing weeds in the fall, or spring prior to emergence of any crop.
			• Allow 5–7 days translocation time after application before doing any tillage when conditions are good. If cool temperatures follow application, allow additional time for translocation to be completed before disturbing treated weeds.
			• Only weeds emerged at application time will be controlled. Additional weed control programs will be necessary to control weeds germinating later.
			• Repeat application to regrowth may be necessary for complete control.
			• For **annual weeds**, use 0.75 to 3.5 L product/ha (0.3 to 1.4 L/ac).
			  ▪ Use 50–100 L/ha water (20–40 L/ac) for the low rate, or use a surfactant with larger water volumes.
			  ▪ Water volumes of 100–300 L/ha water (40–120 L/ac) can be used with the 3.5 L/ha rate.
			• For **dandelions and quackgrass**, use 2.5 to 7 L product /ha (1 to 2.8 L/ac).
			  ▪ Apply when plants have at least 3–4 new leaves.
			  ▪ The low rate (2.5 L/ha (1 L/ac)) will provide a minimum of 1 season control while higher rates (4.75 to 7 L/ha (1.9 to 2.8 L/ac)) will provide longer term control.
			  ▪ For dandelion control apply 2.5 L/ha (1 L/ac) if 15 cm or less in diameter and 3.5 to 5 L/ha (1.4 to 2 L/ac) if larger than 15 cm.
			• For **perennial broadleaf weeds**, use 7 to 12 L product/ha (2.8 to 4.8 L/ac)
			  ▪ Canada thistle and sow-thistle should be at least in early bud, milkweed at bud, bindweed at full flower, and dogbane past full bloom for best results.
			• For undisturbed perennials such as sod in non-crop areas, use the highest rate and repeat it when plants regrow to optimum stage.

glyphosate (360 g/L)	0.75 to 12 L/ha	0.3 to 4.8 L/ac	
* Various formulations are available, see Table 1. See label for specific uses and rates.			
paraquat	1.1 kg/ha		• Use as a chemical mower. • Can be used several times during the year. • Direct spray to avoid the leaves or green bark of nursery plants. • For spot treatments use 25 mL product in 4 L water.
GRAMOXONE (200 g/L)	5.5 L/ha	2.2 L/ac	

Woody Nursery Stock — Container Stock

To convert kg/ha or L/ha to g/ha or mL/100 m²: Multiply by 10 and change units to 100 m².

Example 11 kg/ha becomes 110 g/100 m²
28.4 L/ha becomes 284 mL/100 m²

Do NOT apply herbicides within covered polyhouses, or within four weeks before covering. Certain types of container stock may be injured by the following herbicides. Check manufacturer's directions for labeled species/cultivars before use.

PREPLANT INCORPORATED (PPI) — Two incorporations at right angles operating at a depth of 10 cm using a double disk (7–10 km/hr) or vibrating shank S-tine cultivator (10–13 km/hr) are required unless otherwise stated. Cultivation-type equipment used for herbicide incorporation is known to spread perennial weeds to previously uninfested areas. Special attention should be directed toward machinery cleanliness, and/or treating fields with perennial weeds last.

PREEMERGENCE (PRE) — Rainfall of 15–20 mm within 7–10 days after application is necessary to activate preemergence treatments. Shallow cultivation, rotary hoeing or harrowing will control weed escapes and improve herbicide activity in the absence of rainfall.

Woody Nursery Stock (Container Stock) — Soil Applied Broadleaf Herbicides			
isoxaben GALLERY (75 DF)	0.75 kg/ha 1 kg/ha	 0.4 kg/ac	▪ PRE — For use in bareroot and container conifer seedlings. ▪ Applied prior to weed emergence in conifers, four or more weeks after crop germination and emergence. ▪ Rainfall or irrigation is needed to activate the herbicide. ▪ Registered for use only by members of the Canadian Forest Nursery Weed Management Association.
Woody Nursery Stock (Container Stock) — Soil Applied Grass and Broadleaf Herbicides			
dichlobenil CASORON 4G (4 Gr)	4.4 kg/ha 110 kg/ha	 44 kg/ac	▪ PRE — Apply at least 4 weeks after planting into containers to a weed free soil surface. ▪ **Do NOT** use after September 15 or within 30 days of covering treated stock in overwintering structures. ▪ Use only on containers growing outside. ▪ For use on these species — *Juniperus chinensis, J. horizontalis* and *Thuja occidentalis.*
napropamide DEVRINOL 50W (50 WP) DEVRINOL DF (50 DF) DEVRINOL 10G (10 Gr)	4.5 kg/ha 9 kg/ha 9 kg/ha 45 kg/ha	 3.6 kg/ac 3.6 kg/ac 18 kg/ac	▪ PPI — Apply at any time of the year to a weed free soil surface. ▪ May be applied to newly planted container stock after the potting media has settled from first watering. ▪ Incorporate by watering within 7 days of a spring or fall application and within 2 days of a summer application. ▪ Will not control bittercress.
oxadiazon RONSTAR 2G (2 Gr)	2 to 4.5 kg/ha 100 to 225 kg/ha	 40 to 90 kg/ac	▪ PRE — Apply any time during the year, prior to weed seed germination. ▪ Can be applied to both newly transplanted and established ornamentals and trees. ▪ **Do NOT** apply to wet foliage or under conditions in which granules will collect on leaves. ▪ Consult the label for list of tolerant species. ▪ Apply at least 4 weeks before covering polyhouses in fall.
simazine PRINCEP NINE-T (90 WG) SIMAZINE 80W (80 WP)	2.25 kg/ha 2.5 kg/ha 2.8 kg/ha	 1 kg/ac 1.12 kg/ac	▪ PRE — Apply in 300 L/ha (120 L/ac) water. ▪ For use on juniper, white cedar and yew only. ▪ Apply once per season, 1 month after planting. ▪ Apply before weeds emerge or after removing them from the containers.
Woody Nursery Stock (Container Stock) — Postemergent Grass Herbicides			
POSTEMERGENCE — Leaf stage of the weeds is critical for good weed control. Smaller weeds are generally easier to kill but there needs to be enough leaf surface to intercept the herbicide. Apply according to recommended leaf stages. Crop stage is important to optimize crop safety. Adjuvants will frequently improve the weed control when used as directed. Weather or other conditions may influence the optimum rate of adjuvant, see the product label for more details. Always use appropriate drift management technology.			

Active ingredient TRADE NAME Formulation	RATE (active) PRODUCT PER HA	RATE PRODUCT PER ACRE	PRECAUTIONS (For more information see "Notes on Chemicals" section)
fluazifop-p-butyl VENTURE L (125 g/L)	0.075 to 0.25 kg/ha 0.6 to 2 L/ha	0.24 to 0.8 L/ac	• Apply to actively growing grasses prior to tillering. • Apply at 0.6 L/ha (0.24 L/ac) at 2–5 leaf stage of annual grasses (2–4 leaf for foxtails). • Apply at 0.8 L/ha (0.32 L/ac) at 2–5 leaf stage of volunteer wheat and barley. • Apply at 2 L/ha (0.8 L/ac) at 3–5 leaf stage of quackgrass & wirestem muhly. • Thorough preplant tillage, fragmenting quackgrass rhizomes improves control. • **Do NOT** cultivate between rows until 5 days after application. • Consult the label for list of tolerant species. Use as a directed application in sensitive species to avoid contact with leaves and green tissue. Some blue junipers (e.g. 'Bar Harbour', 'Blue Acres', and 'Blue Rug') can be injured by over-the-top applications. • **Caution** — There are differences between cultivars in sensitivity to FUSILADE. Example — *Juniperus horizontalis* 'Blue Acres' is sensitive while cv 'Plumosa Compacta' is tolerant. • Test on samples of each cultivar not specifically listed on the label before using the herbicide or use as a directed application.

Driveways, Patios and Paths

To convert kg/ha or L/ha to g/ha or mL/100 m²: Multiply by 10 and change units to 100 m².
Example — 11 kg/ha becomes 110 g/100 m²
28.4 L/ha becomes 284 mL/100 m²

Driveways, Patios And Paths — Postemergent Grass and Broadleaf Herbicides

glyphosate CLEAR-IT (7 g/L) ROUNDUP L & G (assorted)			• These products are packaged in small quantities for the home garden trade. • Use low pressure and a coarse spray to prevent drift onto lawns, flowers, vegetables and green leaves of desirable plants.
paraquat GRAMOXONE (200 g/L)	0.6 to 1.1 kg/ha 3 to 5.5 L/ha in 275 L/ha water	1.2 to 2.2 L/ac in 110 L/ac water	• This product is not available to the home gardener but can be used by nurserymen, landscape contractors and farmers. • Use as a directed spray to avoid wetting the leaves and green bark of shrubs, and other desirable plants. • For spot treatments use 30 mL of product in 10 L water per 100 m².
paraquat/ diquat WEED AND GRASS KILLER ((1:1)5 SG) WEED-BAN ((1:1)5 SG)			• These products are packaged in small quantities for the home garden trade. • The granules are readily dissolved in water so that application can be made with a watering can or garden sprayer. • It is used as a "chemical mower". • Use low pressure and a coarse spray to prevent drift onto lawns, flowers, vegetables and green leaves of other desirable plants.

Seedbeds and Potting Soil

To convert kg/ha or L/ha to g/ha or mL/100 m²: Multiply by 10 and change units to 100 m².

Example — 11 kg/ha becomes 110 g/100 m²
28.4 L/ha becomes 284 mL/100 m²

Seedbeds And Potting Soil — Soil Applied Fumigants

dazomet BASAMID (98 Gr)	500 kg/ha 510 kg/ha	204 kg/ac	• **Do NOT** use below 6°C. • See Chapter 4, Notes on Herbicides. • Refer to manufacturer's directions for specific details as well as direction on sealing soil, evacuating gases and performing the safety germination test.
metam sodium VAPAM (380 g/L)	3.8 kg/100 m² 10 L/100 m² in 800 L water		• Apply as a drench to a soil that should be wet to a depth of at least 8 cm. • **Do NOT** plant for 10–14 days or longer if the weather is cool.
methyl bromide/ chloropicrin TERR-O-GAS 67 (67 Li)			• A poisonous gas which must be applied under a gas proof cover (usually plastic). • Its use is subject to the *Pesticides Act*. • It may be used by the grower on his own seedbeds but he must obtain a permit from the Ontario Ministry of the Environment each time it is used. • The manufacturer's instructions must be followed, and the seedbed or greenhouse aired thoroughly after the treatment period. • If there is any question, the safety precautions in the Pesticides Act should be studied, or inquiry made at the resource centres of the Ontario Ministry of Agriculture, Food and Rural Affairs or the Ontario Ministry of the Environment.

Notes:

Weed control ratings are given as 0–9 where 0 indicates no control and 9 indicates 90%–100% control under ideal conditions.
Ratings are subjective values based on best available information and give general comparisons based on use as descibed in this guide.
Under unfavorable conditions (eg., too dry, too wet, too cold, or poor application) the herbicides may not be as effective as indicated.
Ratings may vary with weed and crop stage and with the timing and rates of the product(s) being used.
Ratings in **BOLD** indicate the weed is listed on the product label for control or suppression.
Please see product label for more information on registered weed species, product uses and precautions.

TABLE 24. Nursery Herbicide Weed Control Ratings

Trade Name	Annual Grass					Annual Broadleaves							Perennial Weeds																		
	barnyard grass	crabgrass	fall panicum	foxtail	old witch grass	chickweed, common	groundsel	lady's-thumb	lamb's-quarters	mustards	pigweeds	ragweed	bindweeds	brome grass	chickweed, mouse-eared	dandelion	grape, wild	ground-ivy (creeping-charlie)	horsetail	mallow	milkweed	nutsedge	plantains	poison-ivy	quackgrass	sow-thistle	stinging nettle	thistle, Canada	toadflax, yellow	vetches	virginia creeper
KERB	**8**	7	**8**	**8**	**8**	**7**	?	7	8	8	7	7	?	8	?	?	?	?	5	?	6	6	?	?	**6**	?	?	6	?	?	?
GALLERY	?	?	?	?	?	?	?	?	**?**	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?
CIPC	8	9	7	8	7	?	?	8	7	5	7	5	?	7	?	?	?	?	5	?	?	?	?	?	5	5	?	5	?	?	?
CASORON	7	**6**	6	**6**	7	**8**	**8**	**8**	**8**	**8**	**8**	8	**7**	5	7	**7**	5	6	**8**	?	?	**7**	**7**	?	**7**	**7**	?	**7**	?	**7**	?
DEVRINOL	**8**	**9**	**8**	**8**	8	**7**	**7**	6	**8**	5	**8**	**7**	5	8	?	5	?	?	5	?	5	6	?	?	5	5	?	5	?	5	?
RONSTAR 2G	**7**	**8**	?	**8**	?	5	**8**	?	**8**	8	**7**	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?
DUAL MAGNUM	**9**	**9**	**9**	**9**	**9**	?	?	2	7	2	**7**	4	?	0	?	?	?	?	?	?	?	**8/9**	?	?	**0**	?	?	?	?	?	?
SIMADEX, SIMAZINE 480 or PRINCEP NINE-T	**8**	7	6	**8**	**8**	8	8	**9**	**9**	9	9	**8**	5	8	?	?	?	?	5	?	5	6	?	?	6	5	?	5	?	5	?
TREFLAN, BONANZA or RIVAL	**9**	**9**	8	**8**	8	**7**	5	2	**8**	2	**8**	2	2	?	**7**	?	?	?	**4**	?	5	5	?	?	2	2	?	2	?	2	?
VENTURE L	**8**	**8**	**8**	**8**	**9**	0	0	0	0	0	0	0	?	8	3	3	3	3	?	3	?	?	3	3	**8**	?	3	?	3	3	3
GLYPHOS, ROUNDUP TRANSORB [1]	**9**	**9**	**9**	**9**	**9**	**8**	**8**	**8**	**9**	**9**	**9**	**9**	**8**	8	**9**	**8/9**[b]	8	5	5	5	**8**	**8**	**9**	**9**	**9**	**8**	5	**9**	5	5	8
GRAMOXONE	**8**	**8**	**8**	**8**	**8**	**8**	**8**	**8**	**8**	**8**	**8**	**8**	5[a]	8	5[a]	5[a]	5[a]	5[a]	5[a]	5[a]	5[a]	5[a]	5[a]	5[a]	**5**[a]	5[a]	5[a]	5[a]	5[a]	5[a]	5[a]

[1] Do not allow spray to contact green bark or leaves of crop

? Insufficient information available to make a rating

a Repeated treatments may provide control.

b use higher rates for weeds larger than 15 cm tall or across

CHAPTER 17. TURFGRASS (LAWNS, PARKS, GOLF COURSES, AND SOD FARMS)

To convert kg/ha or L/ha to g/100m² or mL/100m² — Multiply by 10 and change units.
For example — 11 kg/ha becomes 110 g/100m²
28.4 L/ha becomes 284 mL/100m²

MANAGING WEEDS IN TURFGRASS — The major species of broadleaf weeds infesting lawns in Ontario are dandelion, plantain, black medick, chickweed, prostrate knotweed, mallow, henbit, ground-ivy, and white clover. The major grassy weeds are crabgrass, annual bluegrass, quackgrass, orchard grass and bentgrass.

CULTURAL PRACTICES TO MANAGE WEEDS IN TURFGRASS — The easiest, cheapest and most effortless way to keep lawns free of weeds is to encourage vigorous growth of turfgrass. Most weeds cannot compete in a dense, healthy turf. Growth practices that encourage vigorous grass growth discourage weed infestations. Such practices include proper irrigation and drainage, use of fertilizers, insect and disease control, and the use of the correct type of turfgrass for the situation.

Mowing stimulates bud development and tillering, inducing the sod to become thick and dense. Commonly grown grasses such as the fescues, bluegrasses and turf-type perennial ryegrasses should be cut at a height of 4–6 cm. Invasion by weeds may occur, if grasses are cut shorter than 4 cm.

Avoid scalping the turf when cutting around trees and flowerbeds. Do not remove more than one-third of the leaf area when mowing. Mowing too frequently may reduce the carbohydrate reserves of the turf, thereby reducing its competitiveness. Mowing can also be used to remove annual weeds and eliminate seed production, reducing or preventing the spread of weeds.

Fertilizer is particularly important in establishing a thick, dense, and healthy turf sward. Too few nutrients applied to the turf will lead to increased susceptibility to disease and insects. If this happens, the root system of the turf will not develop and the grass will not be able to withstand traffic or recover from injury. Too much fertilizer may lead to soft, weak grass that is prone to disease damage.

Watering is critical during periods of drought that may injure, kill or induce dormancy in the turf, thereby allowing weeds to become established. Irrigate weekly, using 3 cm of water per application to help produce deep-rooted turf.

Frequent light sprinkling will have the opposite effect on the grass roots. Light water applications encourage the germination and growth of shallow rooted species such as crabgrass and creeping bentgrass. Too much irrigation water will lead to infestation by yellow nut sedge and annual bluegrass. Remember to provide adequate watering near trees and hedges because they compete for available moisture.

Drainage is important to ensure that waterlogging does not occur, so adequate drainage should be installed if needed.

Compaction should be avoided to prevent invasion by weeds that thrive in compacted soil. Knotweed and annual bluegrass often invade turfgrass where compaction, caused by excessive traffic, is a problem. While aeration practices do help, the best answer is to modify the area to reduce traffic. Immediate resodding or reseeding of damaged areas discourage weed infestations.

Turfgrass species should be selected to match the growth conditions. For example, fescues are tolerant to low-light intensity in shaded areas under trees, whereas turf-type perennial ryegrass varieties are quick to establish in newly seeded areas and will crowd out germinating weeds. Kentucky bluegrass, although slow to establish, is very competitive once established.

Mechanical removal of weeds can be very effective, provided weed populations are not too high. Weeds can be removed by hand pulling, with a knife or V-shaped spudding tool.

CHEMICAL WEED CONTROL is often the easiest, most effective and cheapest way to control annual and perennial weeds when populations are very high.

New Turf — After seeding new turf, many annual weeds may emerge before the grass seedlings are up. If these young weeds are not controlled, they will shade and eventually crowd out much of the grass population. Mowing at a height of 6–8 cm will eliminate many such weeds. If they are extremely thick, 2,4-D at 1/2 the usual concentration (0.4–0.6 kg in 800 L water/ha) or mecoprop (0.4–0.6 kg in 400 L water/ha) can be used — but not before the grass had been up at least 4 weeks.

Established Turf — Applications of 2,4-D are most effective in the spring, or in September when the weeds are growing well. This treatment generally thins clover in the lawns. Weeds not normally controlled by 2,4-D may be controlled by mecoprop, and dicamba, or with combinations of these 3 herbicides. Mecoprop and dicamba are also sold in commercial mixtures with 2,4-D. See **Table 23 Classification of Weeds According to Response to Foliage Sprays** for information on the response of common weeds to various herbicides. Thorough wetting of the weed foliage is emphasized.

Do NOT use mixtures containing dicamba close to shrubs, or other susceptible ornamentals, at rates above 0.425 kg/ha (active). Prepared mixtures of this chemical and 2,4-D are effective on a wide range of lawn weed species, including knotweed, which is not controlled by most other herbicides except when very young.

Broadleaf Herbicides:

- 2,4-D will control many broadleaf weeds including dandelion, lamb's-quarters, mustards, peppergrass, pigweeds, plantains, shepherd's purse, smartweeds, vetch.
- Mecoprop will control many 2,4-D and MCPA tolerant weeds such as chickweeds, clovers, ground ivy and black medick, and is generally safer to use on bentgrass than 2,4-D.
- Dicamba will control broadleaf weeds including 2,4-D tolerant weeds such as chickweeds, clover and young knotweed but will not adequately control plantain.
- MCPA will control field horsetail, dandelion, lamb's-quarters, mustards, plantains, shepherd's purse, and wild carrot. Weeds tolerant to MCPA include chickweeds, clovers and black medick. Two and three way mixes of these herbicides extend the spectrum of weeds that are controlled by using only one of these herbicides.

Grass Herbicides — BETASAN and DIMENSION can be applied before crabgrass emerges in the spring, and ACCLAIM SUPER and DIMENSION can be applied after emergence.

Active ingredient TRADE NAME (Formulation)	RATE (active) PRODUCT PER HA	RATE PRODUCT PER ACRE	PRECAUTIONS For more information see Chapter 4 Notes on Herbicides and Chapter 5 Notes on Adjuvants
Site Preparation Before Turfgrass Establishment			
Apply in 200–300 L/ha (80–120 L/ac) water.			

glyphosate*	0.27 to 4.32 kg/ha		• Glyphosate is a non-selective herbicide that will kill turf that is sprayed.
			• For actively growing weeds in the fall, or spring prior to planting (otherwise turf will be killed).
			• Allow 5–7 days translocation time after application before doing any tillage when conditions are good. If cool temperatures follow application, allow additional time for translocation to be completed before disturbing treated weeds.
			• Only weeds emerged at application time will be controlled. Additional weed control programs will be necessary to control weeds germinating later.
			• Repeat application to regrowth may be necessary for complete control.
			• For **annual weeds**, use 0.75 to 3.5 L product/ha (0.3 to 1.4 L/ac).
			  ▪ Use 50–100 L/ha water (20–40 L/ac) for the low rate, or use a surfactant with larger water volumes.
			  ▪ Water volumes of 100–300 L/ha water (40–120 L/ac) can be used with the 3.5 L/ha rate.
			• For **dandelions and quackgrass**, use 2.5 to 7 L product /ha (1 to 2.8 L/ac).
			  ▪ Apply when plants have at least 3–4 new leaves. Repeat treatments may be needed.
			  ▪ The low rate (2.5 L/ha (1 L/ac)) will provide a minimum of one season control while higher rates (4.75 to 7 L/ha (1.9 to 2.8 L/ac)) will provide longer term control.
			  ▪ For dandelion control, apply 2.5 L/ha (1 L/ac) if 15 cm or less in diameter and 3.5 to 5 L/ha (1.4 to 2 L/ac) if larger than 15 cm.
			• For **perennial broadleaf weeds**, use 7 to 12 L product/ha (2.8 to 4.8 L/ac)
			  ▪ Canada thistle and sow-thistle should be at least in early bud, milkweed at bud, bindweed at full flower, and dogbane past full bloom for best results.
			• For undisturbed perennials such as sod in non-crop areas, use the highest rate and repeat it when plants regrow to optimum stage.

glyphosate (360 g/L)	0.75 to 12 L/ha	0.3 to 4.8 L/ac	

* Various formulations are available, see Table 1. See label for specific uses and rates.

Turfgrass — Preemergence Grass Herbicides

Apply in 800–1000 L/ha (320–400 L/ac) water, unless otherwise stated.

bensulide BETASAN (480 g/L) or BETASAN (GR) (12.5 Gr)	11 to 14.4 kg/ha 23 to 30 L/ha 125 kg/ha	 9.2 to 12 L/ac 50 kg/ac	• PRE — Apply to established turf before crabgrass emergence in early spring, or in fall. • Use the low rate for crabgrass and the high rate for annual bluegrass. • **Do NOT** reseed the area for 1 year following treatment. • **Do NOT** apply peatmoss to lawn before application. • Use on mineral soils **ONLY**.
dithiopyr DIMENSION (120 g/L)	0.42 kg/ha 3.5 L/ha	 1.4 L/ac	• PRE — Apply in established turf before crabgrass emergence. • See POST application below. • Apply in 200–800 L/ha (80–160 L/ac) water. • Allow turf to recover from aeration, or other stresses before application. • **Do NOT** apply to putting greens during the first year of establishment. • Check label for sensitive varieties, including Colonial bentgrasses. • **Do NOT** irrigate within 2 hr. of application. • **Do NOT** reseed for 3 months after application. • May be tankmixed with KILLEX or other broadleaf herbicides. • **Do NOT** tank-mix with other products for application to putting greens.

Turfgrass — Postemergence Grass Herbicides

Apply in 400–800 L/ha (160–320 L/ac) water.

dithiopyr DIMENSION (120 g/L)	0.42 to 0.54 kg/ha 3.5 to 4.5 L/ha	 1.4 to 1.8 L/ac	• POST— For established turf until crabgrass reaches the 1–3 leaf stage before tillering; **NOT** recommended after 3 leaf stage. See PRE application above. • Use higher rate for larger plants or when area is heavily infested. • Apply in 200–800 L/ha (80–160 L/ac) water. • Allow turf to recover from aeration, or other stresses before application. • **Do NOT** apply to putting greens during the first year of establishment. • Check label for sensitive varieties, including Colonial bentgrasses. • **Do NOT** irrigate within 2 hr. of application. • **Do NOT** reseed for 3 months after application. • May be tank-mixed with KILLEX or other broadleaf herbicides • **Do NOT** tank-mix with other products for application to putting greens.
fenoxaprop-p-ethyl ACCLAIM SUPER (80.5 g/L)	0.092 kg/ha 1.14 L/ha	 0.46 L/ac	• POST — For the control of crabgrass at the 1–4 leaf up to the multi-tiller stage. • Good coverage is essential to control multi-tillered or grassy weeds in the reproductive phase. • Make a second application on mature monostands 21 days after first application. • **Do NOT** apply to bentgrass or seedling Kentucky bluegrass. • **Do NOT** tank-mix with any other herbicide or pesticide. • **Do NOT** apply broadleaf herbicides 7 days before or after ACCLAIM SUPER. • **Do NOT** apply during periods of drought stress. • **Do NOT** mow grass for 4 days before or after application. • **Do NOT** irrigate within 3 hr. after application.

Active Ingredient TRADE NAME (Formulation)	RATE (active) PRODUCT PER HA	RATE PRODUCT PER ACRE	PRECAUTIONS For more information see Chapter 4 Notes on Herbicides and Chapter 5 Notes on Adjuvants
Turfgrass — Postemergence Broadleaf Herbicides			
Apply in 200–400 L/ha (80–160 L/ac) water. Avoid contact with ornamentals and flowers. Avoid applying during hot, dry weather. **DO NOT** irrigate, rake, and/or mow until at least 24 hours after application. **DO NOT** apply to newly seeded lawns until after second mowing.			
2,4-D * 2,4-D (470 g/L)	0.8 to 1.4 kg/ha 1.7 to 3 L/ha	 0.68 to 1.2 L/ac	▪ To control many broadleaf weeds including dandelion, lamb's-quarters, mustards, peppergrass, pigweeds, plantains, shepherd's purse, smartweeds, and vetch. ▪ Damage may occur when applied to bentgrass. ▪ If used on bentgrass apply at 0.28 kg/ha. Some yellowing of bentgrass may occur.
2,4-D * 2,4-D (470 g/L) plus mecoprop MECOPROP (150 g/L) or mecoprop/ 2,4-D MECOTURF PLUS 2,4-D ((1:1)400 g/L) or mecoprop/ 2,4-D PREMIUM 2-WAY TURF HERBICIDE ((1:1)400 g/L) or mecoprop/ 2,4-D MECOPROP PLUS 2,4-D ((0.9:1)194 g/L)	0.85 to 1.1 kg/ha 1.81 to 2.34 L/ha 0.85 to 1.1 kg/ha 5.67 to 7.34 L/ha 1.7 to 2.2 kg/ha 4.25 to 5.5 L/ha 2 kg/ha 5 L/ha 2.14 kg/ha 11 L/ha	 0.72 to 0.93 L/ac 2.27 to 2.93 L/ac 1.7 to 2.2 L/ac 2 L/ac 4.4 L/ac	▪ May be combined with VANQUISH (0.21 L/ha (0.08 L/ac)) for control of young knotweed. ▪ Damage may occur when applied to bentgrass. ▪ For newly established turf at least 4 weeks old, use 2,4-D at 1/2 the usual concentration (0.4–0.6 kg in 800 L water/ha) or mecoprop (0.4–0.6 kg in 400 L water/ha) for annual weeds.
2,4-D/ dicamba/ mecoprop KILLEX (308 g/L) or PREMIUM 3-WAY TURF HERBICIDE (308 g/L) or PAR III (308 g/L)	1.7 kg/ha 5.5 L/ha 5.5 L/ha 5.5 L/ha	 2.2 L/ac 2.2 L/ac 2.2 L/ac	▪ To control 2,4-D and MCPA tolerant weeds such as chickweeds, clovers, ground ivy and black medick as well as many broadleaf weeds including dandelion, lamb's-quarters, mustards, peppergrass, pigweeds, plantains, shepherd's purse, smartweeds, and vetch. ▪ In closely mowed bentgrass (greens) apply at half doses (30 mL/100 m²). ▪ Temporary yellowing of bentgrass may occur. ▪ Recovery from injury will occur 1 week after application ▪ See **Precautions** for VANQUISH.
bentazon BASAGRAN (480 g/L) plus oil concentrate ASSIST	0.84 kg/ha 1.75 L/ha 2 L/ha	 0.7 L/ac 0.8 L/ac	▪ To control top growth of yellow nut sedge. Apply when nut sedge is young and actively growing. Make 2 applications 10 days apart. ▪ **Do NOT** mow grass 3–5 days before and after application. ▪ **Do NOT** treat newly seeded turf until well established.
dicamba VANQUISH (480 g/L)	0.6 kg/ha 1.25 L/ha	 0.5 L/ac	▪ **Do NOT** apply to bentgrass. ▪ **Do NOT** apply near shallow rooted perennials to avoid root uptake and injury. ▪ To control broadleaf weeds including 2,4-D tolerant weeds such as chickweeds, clover and young knotweed, but will not adequately control plantain ▪ VANQUISH alone is recommended for use in certain situations only; it is best when mixed at low use rates with phenoxy herbicides. ▪ Prepared mixtures of VANQUISH and 2,4-D are effective on a wide range of lawn weed species, including knotweed, which is not controlled by most other herbicides except when very young.

			• **Do NOT** use mixtures containing VANQUISH close to shrubs, or other susceptible ornamentals, at rates above 0.425 kg/ha (active). • **Do NOT** mow grass 3–5 days before and after application. • **Do NOT** treat newly seeded turf until well established.
MCPA ESTEMINE MCPA (500 g/L)	1.1 to 1.4 kg/ha 2.2 to 2.8 L/ha	0.88 to 1.12 L/ac	• For control of field horsetail, dandelion, lamb's-quarters, mustards, plantains, shepherd's purse, and wild carrot. • **Do NOT** apply to bentgrass unless necessary, and then only at 0.28 kg/ha. Some yellowing of bentgrass may occur. • Use as a substitute for 2,4-D. At slightly higher doses than 2,4-D it will usually provide as good weed control as 2,4-D. • Reduced control of dandelion and plantain may occur during dry, hot weather.
mecoprop COMPITOX (150 g/L) MECOPROP (150 g/L)	0.83 to 1.28 kg/ha 5.5 to 8.5 L/ha 5.5 to 8.5 L/ha	 2.2 to 3.4 L/ac 2.2 to 3.4 L/ac	• To control 2,4-D and MCPA tolerant weeds such as chickweeds, clovers, ground ivy and black medick, as well as many broadleaf weeds. • May be applied to bentgrass. • Apply before flower to dandelion. • Repeated applications may be needed for dandelion and black medick.
mecoprop/ 2,4-D EXPEDITE BROADLEAF ((1:2)186 g/L)	1.8 to 2.6 kg/ha 9.5 to 14 L/ha	 3.8 to 5.6 L/ac	• Must be applied with the EXPEDITE APPLICATION SYSTEM.
Turfgrass Renovation			
The turf to be renovated should be mowed and thoroughly raked to remove all dead and cut vegetation.			
paraquat GRAMOXONE (200 g/L)	2.4 kg/ha 12 L/ha	 4.8 L/ac	• Apply in 1000 L/ha (400 L/ac) water. • This treatment will "burn off" all emerged vegetation. • When the old turf is dead, rotovate top 5 cm to cover dead grass, rake the surface to prepare seedbed and reseed.
glyphosate* glyphosate (360 g/L)	1.7 to 2.5 kg/ha 4.75 to 7 L/ha	 1.9 to 2.8 L/ac	• Apply in 200–300 L/ha (80–120 L/ac) water after omitting at least 1 regular mowing. • Ideally tillage should be delayed 7 days after application to allow for proper translocation into underground plant parts. • Direct seeding into the killed turf (no tillage) may be carried out.

* Various formulations available, see Table 1. See label for specific uses and rates.

Turfgrass Retardation

Reduction in grass growth may be brought about by treatment with maleic hydrazide (Royal MH 60 SG, 6.5 to 8 kg/ha (2.6 to 3.2 kg/ac) product). Manufacturer's directions should be followed carefully. This chemical is recommended for use in areas where mowing and trimming are difficult and where a lawn like appearance is not necessary. See Chapter 4, Notes on Herbicides.

Notes:

Weed control ratings are given as 0–9 where 0 indicates no control and 9 indicates 90%–100% control under ideal conditions.

Ratings are subjective values based on best available information and give general comparisons based on use as descibed in this guide.

Under unfavorable conditions (eg., too dry, too wet, too cold, or poor application) the herbicides may not be as effective as indicated.

Ratings may vary with weed and crop stage and with the timing and rates of the product(s) being used.

Ratings in **BOLD** suggest the weed is listed on the product label for control or suppression.

Please see product label for more information on registered weed species, product uses and precautions.

TABLE 25. Turfgrass Herbicide Weed Control Ratings

Trade Name	crabgrass	bentgrass	bluegrass, annual	chickweed, common	black medick	chickweed, mouse-eared	clover, white	dandelion	ground-ivy (creeping-charlie)	knotweed	mallow	nutsedge, yellow	plantains	quackgrass
[redacted]														
BETASAN	**9**	?	**3**	?	?	?	?	?	?	?	?	?	?	?
DIMENSION	**9**	?	?	?	?	?	?	?	?	?	?	?	?	?
[redacted]														
ACCLAIM SUPER	**9**	?	?	?	?	?	?	?	?	?	?	?	?	?
DIMENSION	**8**	?	?	?	?	?	?	?	?	?	?	?	?	?
[redacted]														
2,4-D*	?	?	?	3	**5**	3	3	**9**	3	4	4	?	**9**	?
BASAGRAN	?	?	?	?	?	?	?	?	?	?	?	**8**	?	?
VANQUISH	?	?	?	8	6	**8**	**8**	9	8	8	6	**?**	4	?
ESTAMINE MCPA	?	?	?	4	4	**3**	**3**	**6**	3	3	3	**?**	**9**	?
GRAMOXONE	?	?	?	?	?	?	?	?	?	?	?	?	?	?
KIL-MOR, PREMIUM 3-WAY TURF HERBICIDE, PAR III	?	?	?	**8**	**8**	**8**	**8**	**9**	**6**	**7**	6	**?**	**9**	?
MECOPROP, COMPITOX	?	?	?	**8**	**8**	**8**	**8**	**6**	**7**	3	3	**?**	6	?
MECOTURF PLUS 2,4-D, PREMIUM 2-WAY HERBICIDE, MECOPROP PLUS 2,4-D, EXPEDITE BROADLEAF	?	?	?	**8**	**8**	**7**	**8**	**9**	**2**	**3**	3	**?**	**9**	?
ROUNDUP, GLYFOS, EXPEDITE GRASS & WEED, CLEAR-IT	?	**9**	?	?	?	?	?	?	?	?	?	?	?	**9**
[redacted]														
2,4-D + mecoprop*	?	?	?	**8**	**8**	**7**	**8**	**9**	**2**	**3**	3	?	**9**	?

* Various formulations available, see Table 1.

? Insufficient information available to make a rating

CHAPTER 18. ROADSIDES AND NON-CROP AREAS

Roadsides, Rights-of-Ways, Fencerows and Non-crop Areas

Fencerows and Farm Areas

In agricultural areas, weeds growing in fencerows, around buildings and on roadsides are sources of potential weed infestation to other parts of a farm. In addition, brush and weeds around fields harbor insects, diseases and other pests that may be detrimental to farming operations. Shrubs like wild cherry may be possible sources of livestock poisoning.

Farmers may also wish to reclaim land on which willows or brush have encroached.

It is important to keep drainage ditches and farm ponds free of troublesome aquatic vegetation.

Roadsides, Rights-of-way and Waste Places

Road maintenance personnel are interested in controlling weeds and brush to reduce the cost of winter snow removal programs. Low vegetation will also give the road user clear view of other vehicles, animals, children and other hazards. It is important to prevent brush encroachment onto the roadway proper, to keep the drainage ditches open to prevent flooding and to minimize the fire hazard of tall, dry vegetation in the late summer. A grass cover also prevents soil erosion much better than weeds.

Both railway and power supply authorities are concerned with maintaining safe and accessible rights-of-way by controlling growth of weeds and brush.

In certain areas (beneath guide rails, in storage yards, under railway tracks and under fences at road intersections), it may be advantageous to completely kill all vegetation for a longer period of time. Herbicides and suggestions for their use in this way are presented in the section on **Long Term Total Vegetation Control**.

In roadside and right-of-way spraying, for weed control or brush control, precautions should always be taken to minimize herbicide drift. It is advisable to inspect or monitor each roadside just prior to spraying to locate susceptible crops, water crossings and other sensitive areas. Appropriate "shut off" and "turn on" points should be marked so these areas can be avoided during the actual spray operation.

Brush Control

There are several techniques that may be used for the chemical control of deciduous woody species: stem foliage sprays, basal bark sprays and frilling or spot treatments.

The choice of technique will depend on such factors as brush type, accessibility, availability of equipment, proximity to susceptible crops or ornamental vegetation and the size of the control program.

Stem Foliage Treatments Applied to "Runoff" — Most deciduous woody species

Stem foliage treatment of brush should be limited to smaller growth (less than 2 m in height). Treatments should be applied to thoroughly wet the stems and foliage to the point of runoff. This technique is most effective just after full leaf development in late spring or early summer.

The choice of herbicides for controlling stands of deciduous brush should be based on the susceptibilities of the predominant species (Table 19) or whether the brush to be controlled is near homes, recreational areas, etc.

2,4-D * 2,4-D (470 g/L)	1.7 to 4.2 kg/1000 L 3.6 to 9 L/1000 L	▪ One application may be sufficient for sensitive species. ▪ For intermediately sensitive species, repeated treatments are normally required.
dicamba VANQUISH (480 g/L) plus 2,4-D * 2,4-D (470 g/L)	1.9 kg/1000 L 4 L/1000 L 3.8 kg/1000 L 8 L/1000 L	▪ Apply to the point of runoff when the leaves are fully expanded.
dicamba VANQUISH (480 g/L) plus dichlorprop/ 2,4-D DIPHENOPROP BK 700 (679 g/L)	2.5 kg/1000 L 5.2 L/1000 L 4.9 kg/1000 L 7.15 L/1000 L	▪ For white ash and sugar maple. ▪ Apply to the point of runoff when leaves are fully expanded.

Active ingredient / TRADE NAME Formulation	RATE active / PRODUCT PER HA	RATE PRODUCT PER ACRE	PRECAUTIONS For more information see Chapter 4 Notes on Herbicides and Chapter 5 Notes on Adjuvants
dichlorprop/ 2,4-D DIPHENOPROP BK 700 (679 g/L) ESTAPROP (582 g/L) DICHLORPROP D (582 g/L)	5.1 to 6.8 kg/1000 L 7.5 to 10 L/1000 L 8.75 to 11.7 L/1000 L 8.75 to 11.7 L/1000 L		▪ Apply the **low-volatile ester** in areas dominated by species expected to be tolerant to 2,4-D alone.
fosamine ammonium KRENITE (480 g/L)	4.81 to 7.21 kg/1000 L 10 to 15 L/1000 L		▪ For oak, maple, alder, hickory and ash. ▪ Additional surfactants may be required for difficult species.
glyphosate* glyphosate (360 g/L)	3.6 to 7.2 kg/1000 L 10 to 20 L/1000 L		▪ Most woody and herbaceous species. Can be applied during June, July or August. ▪ Injury to grasses will occur; use other selective products if grasses are to be maintained.
picloram/ 2,4-D TORDON 101 ((1:3.7)305 g/L)	3.05 kg/1000 L 10 L/1000 L		▪ Excluding white ash. ▪ Apply to wet the stems and foliage to the point of runoff when the leaves are fully expanded. ▪ A permit for purchase and use is required.
triclopyr GARLON 4 (480 g/L)	1.92 to 3.84 kg/1000 L 4 to 8 L/1000 L		▪ Apply to the point of run-off when the brush is actively growing. ▪ Use the higher rate for the more difficult species (See Table 19).
Constant Volume Foliar Applications — Most deciduous woody species (excluding white ash)			
For Brush Control on Roadsides and Other Rights-of-Way			
dicamba VANQUISH (480 g/L) plus 2,4-D * 2,4-D (470 g/L)	2 kg/ha 4.2 L/ha 3.8 kg/ha 8 L/ha	1.7 L/ac 3.2 L/ac	▪ Apply in sufficient water (220–330 L/ha) (88–132 L/ac) to wet all foliage. ▪ Amine or ester formulations of 2,4-D may be used.
dicamba VANQUISH (480 g/L) plus dichlorprop/ 2,4-D DIPHENOPROP BK 700 (679 g/L)	2.5 kg/ha 5.2 L/ha 4.9 kg/ha 7.2 L/ha	2.1 L/ac 2.9 L/ac	▪ Apply in sufficient water (200–330 L/ha) (80–132 L/ac) to wet all foliage.
dichlorprop/ 2,4-D DIPHENOPROP BK 700 (679 g/L) ESTAPROP (582 g/L) DICHLORPROP D (582 g/L)	3.8 to 10.2 kg/ha 5.5 to 15 L/ha 6.5 to 17.5 L/ha 6.5 to 17.5 L/ha	2.2 to 6 L/ac 2.6 to 7 L/ac 2.6 to 7 L/ac	▪ Apply in 750 to 1500 L/ha water (300 to 600 L/ac) during periods of active growth. ▪ Rate of mixture depends on brush density or height.
imazapyr ARSENAL (240 g/L)	0.72 kg/ha 3 L/ha	1.2 L/ac	▪ For maple, poplar, raspberry, and wildrose. ▪ Apply in sufficient water (100–550 L/ha) (40–220 L/ac) to wet all foliage during periods of active growth.
picloram/ 2,4-D TORDON 101 ((1:3.7)305 g/L)	5.49 to 7.62 kg/ha 18 to 25 L/ha	7.2 to 10 L/ac	▪ Apply in 450 L/ha water (180 L/ac) during the active growing season. ▪ Use an approved drift control system or additive. ▪ **A permit for purchase and use is required.**
triclopyr GARLON 4 (480 g/L)	1.92 to 3.84 kg/ha 4 to 8 L/ha	1.6 to 3.2 L/ac	▪ Apply this low volatile ester in a minimum of 200 L/ha water (80 L/ac) during periods of active growth.

Basal-Bark Treatments in Oil as a Carrier

The BASAL-BARK treatment is useful on a wide range of trees and brush with a trunk diameter up to about 15 cm. The chemical is applied so as to thoroughly cover the basal 30 cm of the trunk and any exposed roots. For oak, hickory, basswood or ash, treatments are most effective from February to June. Most other species may be treated at any season of the year.

Light, simple equipment, coupled with the possibility of winter operations when labor is cheaper and access to swampy areas possible, give this treatment an important role in a brush control program.

2,4-D * 2,4-D (470 g/L)	3 kg/100 L 6.4 L/100 L	▪ For hawthorn. Use the **low-volatile ester** formulations in fuel oil.
dichlorprop/ 2,4-D DIPHENOPROP BK 700 (679 g/L) ESTAPROP (582 g/L) or dichlorprop/ 2,4-D DICHLORPROP D (582 g/L)	1.9 to 3 kg/100 L 2.8 to 4.4 L/100 L 3.2 to 5.2 L/100 L 1.35 kg/100 L 2.3 L/100 L	▪ For most woody species, including conifers. ▪ Use the **low-volatile ester** formulations in fuel oil. ▪ Spray bark to wet only.
triclopyr GARLON 4 (480 g/L)	9.6 to 14.4 kg/100 L 20 to 30 L/100 L	▪ For hawthorn. ▪ **One Sided Low Volume** — This low volume treatment can be applied to stems less than 15 cm in diameter. Apply the spray to thoroughly wet at least one side of the stem and root crown but not to the point of run-off. ▪ **Streamline** — Apply sufficient spray to one side of stems less than 8 cm in basal diameter to form a band that is 5 cm in width. The treatment zone should widen to encircle the stem within 30 minutes. Treat both sides of stems which are 8 to 12 cm in basal diameter.

Stump Treatment After Cutting to Most Deciduous Woody Species

In many cases, it is more desirable to remove existing brush by hand than to spray it and leave the dead material standing. Chemical stump treatment is particularly useful in preventing the vigorous regrowth that is the characteristic response of many deciduous species after cutting. Moreover killing the stump is the first step towards encouraging it to rot.

Most treatments must be applied to freshly cut stumps to achieve maximum effectiveness. For old stumps, it is best to drill several holes or to split stump with a wedge before applying the treatments. Regrowth from an old stump should be sprayed along with the stump. Various dye materials may be added to the oil based sprays to assure that all exposed surfaces of the stumps are treated. (See Application Indicators)

2,4-D * 2,4-D (470 g/L)	2 kg/100 L 4.25 L/100 L	▪ Apply in oil as a carrier.
dichlorprop/ 2,4-D DIPHENOPROP BK 700 (679 g/L) ESTAPROP (582 g/L) DICHLORPROP D (582 g/L)	1.9 kg/100 L 2.8 L/100 L 3.25 L/100 L 3.25 L/100 L	▪ Apply in oil as a carrier.
dichlorprop/ 2,4-D WEEDONE CB (160 g/L)	1.4 kg/100 L 8.75 L/100 L	▪ Apply undiluted product to all exposed surfaces. ▪ Stumps need not be treated immediately after cutting, thus separate cutting and spraying operations are possible.
picloram/ 2,4-D TORDON 101 ((1:3.7)305 g/L)	3.05 kg/10L 10 L/10L	▪ Dilute 1:1 with water or 1:1 with ethylene glycol if below freezing. ▪ A permit for purchase and use is required.

Active ingredient TRADE NAME Formulation	RATE (active) PRODUCT PER HA	RATE PRODUCT PER ACRE	PRECAUTIONS For more information see Chapter 4 Notes on Herbicides and Chapter 5 Notes on Adjuvants
triclopyr GARLON 4 (480 g/L)	9.6 to 14.4 kg/100 L 20 to 30 L/100 L		• Apply in oil as a carrier to cut stump. • Thoroughly wet all cut surfaces and any exposed bark. • Treatment can be performed any time after mechanical removal.

Evergreen or Conifer Control

Foliage Treatments with Water as a Carrier — Mixed stands (Conifers and Deciduous)

All of the treatments are applied so as to thoroughly wet all foliage. Use low pressure and apply from 500–1500 L/ha solution (200–600 L/ac), depending on the amount of foliage. Thorough coverage is particularly important and the addition of a wetting agent will increase effectiveness.

dicamba VANQUISH (480 g/L) dichlorprop/ 2,4-D DIPHENOPROP BK 700 (679 g/L)	2.5 kg/1000 L 5.2 L/1000 L 4.9 kg/1000 L 7.15 L/1000 L		• Apply in spring or early summer. • Thorough coverage is needed. • Follow instructions on VANQUISH label for tank mix.
dicamba VANQUISH (480 g/L) plus 2,4-D 2,4-D (470 g/L)	1.9 kg/1000 L 4 L/1000 L 3.8 kg/1000 L 8 L/1000 L		• Apply as **amines** in early summer. • Thorough coverage is needed.
paraquat GRAMOXONE (200 g/L)	1 kg/1000 L 5 L/1000 L		• For spruce, balsam, or pine. Apply in spring or early summer. • Thorough coverage is needed. • This treatment can be combined with 2,4-D, dichlorprop treatments that are recommended for the species of deciduous brush present (Table 19).
picloram/ 2,4-D TORDON 101 ((1:3.7)305 g/L)	3.05 kg/1000 L 10 L/1000 L		• Apply when the conifers are actively growing in early summer. • Spray should thoroughly wet all plant parts including stem, foliage, and root collar. • Use an approved drift control system or additive. • A permit is required for purchase and use.
picloram/ 2,4-D TORDON 101 ((1:3.7)305 g/L)	5.49 to 7.62 kg/ha 18 to25 L/ha	7.2 to 10 L/ac	• Apply in 450 L/ha (180 L/ac) water as a constant volume foliar application during the period of active conifer growth in early summer. • Use an approved drift control system or additive. • A permit for purchase and use is required.

General Treatments for Woody Species

Single or scattered trees or shrubs may be controlled efficiently with dry applications of sodium borate or chlorate mixtures. Apply the chemical in a band at the base of the plant, following the manufacturer's directions

Basal (Spot) Treatment

On stands of deciduous or coniferous brush that range from light to scattered, use individual spot treatment with bromacil (HYVAR X-L). It may be applied with an exact delivery hand gun. Apply undiluted at 10 g/m of height (5 cm diameter) or brush or dilute 1 HYVAR X-L with 5 L of water and apply 60 g/m of height of brush. Taller and larger brush requires progressively more herbicide.

Sucker Growth Control After Pruning

Many trees sprout prolifically after they have been pruned. The application of fortified tree wound dressings to the surface of the cuts can reduce the number of new sprouts from many tree species.

These paints improve natural inhibition achieved through the use of poor trimming practice. All pruning should be done to strong laterals. Severe pruning should be avoided.

Best results will be obtained if the materials are applied to the cuts between April 15–July 15. Treatment of all cuts is important, as each is a potential location for sprouting from both dormant and adventitious buds. Cover the entire cut and about 2 cm of the surrounding bark, especially below the cut. Heavy tree wound dressing will adversely affect the rate of callus formulation of some species.

Alpha napthalene acetic acid, ethyl ester (THREHOLD), as a 1% surface tree wound dressing or aerosol can be effective on willow, poplar, maple, oak, elm, basswood, apple and possibly other species.

Tree Injection

Glyphosate as a 0.15 g EZJECT capsule can be used to control woody brush and trees with an EZJECT capsule injection system. Capsules must penetrate through the outer bark and into the inner living tissue to provide effective results. Capsules should be spaced evenly around the tree, below all major branches at a rate of 1 capsule per 5 cm sem diameter at breast height (dbh). Stems should be in excess of 3 cm dbh but usually not in excess of 20 cm dbh. Trees should not be frozen at time of treatment. Allow 1–2 yr. for complete control.

Perennial Weed Control (Non Crop Land)

CAUTION: Unless otherwise recommended, these treatments should not be used in crop situations. Their use should also be avoided if the chemical is likely to wash or leach into areas occupied by the roots of desirable trees or other plants. Precautions should also be followed to avoid spray drift onto non target vegetation.

The use of atrazine, simazine, bromacil, or diuron non selectively, as described, is generally limited by cost to the handling of small patches of perennial weeds. The chemical either leaches down to the weed root system or makes the surface soil toxic for a period of time varying from a few months to several years, depending on the chemical, rate of application and soil type. Generally, crops cannot be grown successfully until the effect of the chemical has disappeared. Corn, however, can be grown safely when high rates of simazine and atrazine are applied.

Some perennial weeds, such as field bindweed, horsetail, goldenrod, milkweed and bracken fern, are difficult to eradicate at the lower rates of diuron, simazine, atrazine and bromacil. Follow the manufacturer's directions carefully if the area is to be re-seeded. The amitrole treatment is of value in spot treating patches of quackgrass in a field that is not entirely infested.

While the tops of many perennial weeds may be controlled by doses of 2,4-D that may be selectively used in resistant crops, heavier doses, as described, must be used if eradication is to be attempted. Several applications upon successive stages of regrowth will probably be necessary. Generally, treatments with 2,4-D during rapid development of the weed at about the early bud to flowering stages of growth are most effective. Spray should be applied to thoroughly wet all foliage.

Heavier doses of 2,4-D on patches of weeds may be applied during normal selective spraying operations merely by slowing down the sprayer speed in the infested areas. Local crop damage should be expected where this is done.

Perennial weeds are more difficult to control than annual weeds because regrowth occurs rapidly from underground parts after the top growth is removed by chemical or mechanical means. In non crop land they pose a special problem because cultivation cannot be used for their control. Chemicals must kill the root system as well as the above ground parts to give effective perennial weed control.

Postemergence Grass Herbicides

amitrole	3 to 4 kg/ha		• Apply to actively growing quackgrass foliage when growth is 15–20 cm in height.
AMITROL 240 (231 g/L)	12.5 to 16.5 L/ha	5 to 6.6 L/ac	• Wait at least 10 days before plowing or disking.

Active Ingredient TRADE NAME Formulation	RATE active ingredient PRODUCT PER HA	RATE PRODUCT PER ACRE	PRECAUTIONS For more information, see Chapter 4 Notes on Herbicides and Chapter 5 Notes on Adjuvants
glyphosate* glyphosate (360 g/L)	0.85 to 0.9 kg/ha 2.35 to 2.5 L/ha	0.94 to 1 L/ac	▪ For a minimum of 1 season control of quackgrass, apply in the fall or spring before planting. ▪ Apply, using flat-fan nozzles, in 50–100 L/ha water (20–40 L/ac). ▪ For use in higher water volumes, the addition of a surfactant such as ENHANCE or LI 700 is recommended.
propyzamide KERB (50 WP)	1.1 to 1.8 kg/ha 2.2 to 3.6 kg/ha	0.88 to 1.44 kg/ac	▪ Apply in fall from late September to early November but before soil freezes. ▪ Control of weeds other than perennial grasses cannot be expected.
Postemergence Broadleaf Herbicides			
2,4-D * 2,4-D (470 g/L)	1 to 2 kg/ha 2 to 4.25 L/ha	0.85 to 1.7 L/ac	▪ Apply in 1000 L/ha water (400 L/ac). ▪ See Table 21 for list of weed susceptibilities to 2,4-D and related chemicals.
amitrole AMITROL 240 (231 g/L)	4.5 to 6.75 kg/ha 18.75 to 28 L/ha	7.5 to 11.2 L/ac	▪ For milkweed control. ▪ Apply in 500–1000 L/ha water (200–400 L/ac) after most shoots have emerged but before flowering.
chlorsulfuron TELAR (75 DF)	90 g/ha 120 g/ha	48 g/ac	▪ For Canada thistle, dandelion, and field horsetail. A surfactant should be added to improve control.
clopyralid TRANSLINE (360 g/L)	0.15 to 0.3 kg/ha 0.42 to 0.83 L/ha	0.17 to 0.33 L/ac	▪ For coltsfoot, spotted knapweed, ragweed, Canada thistle, ox-eye daisy, tufted vetch, scentless chamomile and clover. ▪ Treat when weeds are young and actively growing. ▪ For coltsfoot, treatments should be performed prior to August. ▪ Apply as a broadcast in 200 L/ha water (80 L/ac) or in sufficient water to ensure thorough coverage of target vegetation.
dicamba VANQUISH (480 g/L)	1.108 kg/ha 2.3 L/ha	0.92 L/ac	▪ For field bindweed, leafy spurge and cypress spurge. ▪ Apply sprays in mid June or during flowering, in 100–200 L/ha water (40–80 L/ac). Canada thistle or perennial sow-thistle. ▪ Apply spray in late spring just prior to flowering, or apply to regrowth escaping other treatments, in summer or fall.
dichlorprop/ 2,4-D DIPHENOPROP BK 700 (679 g/L) ESTAPROP (582 g/L) DICHLORPROP D (582 g/L)	2.375 kg/ha 3.5 L/ha 4 L/ha 4 L/ha	1.4 L/ac 1.6 L/ac 1.6 L/ac	▪ Apply as a **low-volatile ester** in 200–600 L/ha water (80–240 L/ac) during the month of May or in early fall.
triclopyr GARLON 4 (480 g/L)	0.48 to 1.92 kg/ha 1 to 4 L/ha	0.4 to 1.6 L/ac	▪ Apply in a minimum of 200 L/ha water (80 L/ac) to ensure uniform coverage.
Postemergence Grass and Broadleaf Herbicides			
bromacil HYVAR X-L (240 g/L)	7.2 to 10.8 kg/ha 30 to 45 L/ha	12 to 18 L/ac	
bromacil/ diuron KROVAR ((1:1)80 DF)	10.8 to 14.4 kg/ha 13.5 to 18 kg/ha	5.4 to 7.2 kg/ac	
dichlobenil CASORON 4G (4 Gr)	11 to 22 kg/ha 275 to 550 kg/ha	110 to 220 kg/ac	▪ To use as a split application, apply CASORON 4G at 150 kg/ha (60 kg/ac) in the fall and again at 150 kg/ha (60 kg/ac) in early spring.

diuron KARMEX (80 DF)	11.2 to 44 kg/ha 14 to 55 kg/ha	 5.6 to 22 kg/ac	• Apply in 1000 L/ha water (400 L/ac).
glyphosate* glyphosate (360 g/L)	2.52 to 4.32 kg/ha 7 to 12 L/ha	 2.8 to 4.8 L/ac	• Apply 200–300 L/ha water (80–120 L/ac) when field bindweed has reached full flower, and Canada thistle and milkweed have reached the bud to bloom stage.
imazapyr ARSENAL (240 g/L)	0.72 kg/ha 3 L/ha	 1.2 L/ac	• Apply in sufficient water (100–550 L/ha or 40–220 L/ac) to wet all foliage during periods of active growth.
picloram/ 2,4-D TORDON 101 ((1:3.7)305 g/L)	2.134 kg/ha 7 L/ha	 2.8 L/ac	• Apply in 200 L/ha water (80 L/ac) during spring or early summer after growth appears. • Use an approved drift control additive or system. • A permit is required for purchase and use.

Poison-Ivy Control

Several chemicals have been shown to be effective for the control of poison-ivy. However, some growth may occur after treatment with any of these chemicals and retreatments will be necessary to achieve eradication. The chemical treatment of poison-ivy must take into account the location in which the weed is growing. If desirable shrubs or trees are present, soil sterilants should be avoided, and the other materials used with caution.

A 9–14 L sprayer is the most convenient method of applying herbicides to patches of poison-ivy. Thorough coverage of the leaves with the spray is essential for maximum effect. After spraying, the area should be left alone until the plants die, at which time the dead stems should be gathered up and buried. Even at this stage care should be taken as poisoning may be brought about by handling the dead plant. All treatments are most effective when the poison-ivy is in full leaf and growing actively, from about June 15–July 31.

Postemergence

amitrole AMITROL 240 (231 g/L)	2.25 kg/ha 9.25 L/ha	 3.7 L/ac	• Apply in at least 1000 L/ha water (400 L/ac) when plants are actively growing. Thoroughly wet all foliage.
dicamba VANQUISH (480 g/L) plus 2,4-D * 2,4-D (470 g/L)	0.82 kg/ha 1.7 L/ha 1.1 kg/ha 2.2 L/ha	 0.68 L/ac 0.88 L/ac	• Apply in at least 560 L/ha water (224 L/ac).
dichlorprop/ 2,4-D DIPHENOPROP BK 700 (679 g/L) ESTAPROP (582 g/L) DICHLORPROP D (582 g/L)	6.8 kg/1000 L 10 L/1000 L 11.7 L/1000 L 11.7 L/1000 L		• Apply spray until foliage is thoroughly wet.
glyphosate* glyphosate (360 g/L)	2.52 to 4.32 kg/ha 7 to 12 L/ha	 2.8 to 4.8 L/ac	• Apply to actively growing plants in 200–300 L/ha water (80–120 L/ac) to thoroughly wet the foliage but do not spray to the point of runoff.
imazapyr ARSENAL (240 g/L)	0.72 kg/ha 3 L/ha	 1.2 L/ac	• Apply in sufficient water (100–550 L/ha (40–220 L/ac)) to wet all foliage during periods of active growth.
triclopyr GARLON 4 (480 g/L)	1.92 to 2.88 kg/ha 4 to 6 L/ha	 1.6 to 2.4 L/ac	• Use a minimum of 200 L/ha (80 L/ac) of spray solution to ensure thorough coverage.

Active ingredient TRADE NAME Formulation	RATE–active PRODUCT PER HA	RATE PRODUCT PER ACRE	PRECAUTIONS For more information see Chapter 4 Notes on Herbicides and Chapter 5 Notes on Adjuvants

Reduction of Herbicidal Drift

In the application of herbicides, especially of the hormone type (2,4-D, mecoprop, dichlorprop, dicamba, etc.) sensitive crops (grapes, tomatoes, turnips, tobacco, beans, carrots, beets, fruit trees, ornamental plants and many others) beyond the area being sprayed can be damaged by vapor or spray drift.

To reduce the danger of herbicidal drift:

1. Use only amine formulations when it is necessary to apply phenoxy herbicides (2,4-D, mecoprop, dichlorprop, etc.) near sensitive, non-target plants.
2. Very slight spray drift with herbicides containing dicamba can be more damaging to soybeans and other crops than equivalent amounts of 2,4-D spray drift. There is also a possibility of dicamba vapor drift from treated plant foliage during high temperatures (in excess of 25°); thus, use of dicamba containing herbicides should be avoided near sensitive, desirable plants.
3. Use the lowest pressure possible to apply the herbicide. This may mean the use of a dribble bar, Radiarc boom, vibrajet nozzle, Directa-spra nozzle, flood jet or more conventional nozzle tips.
4. Manufacturer's recommendations regarding nozzle spacing and height should be carefully followed. It may be necessary to mount nozzles on skids to keep them at a constant distance from the surface to be sprayed.
5. For roadside spraying various spray additives (i.e. NALCO-TROL or 38-F) are available which may reduce spray drift by increasing the viscosity or density of the spray. These materials should be used following manufacturer's directions and observing normal precautions (vehicle speed, wind velocity, proximity to sensitive crops, etc.)

WARNING: These methods and materials can reduce but not eliminate herbicidal drift. In areas near sensitive crops, all normal precautions must be taken. It should be emphasized that extremely low, even invisible, amounts of spray drift can be very damaging to sensitive crops. In some cases, spraying during the growing season should not be considered.

Roadside Weed Control

The main objectives of a weed control program for roadsides are: (1) to control tall growing weeds so that mowing costs can be minimized; (2) to control weeds that may infest adjacent land by wind dispersal of seed; (3) to maintain an attractive grass cover that will minimize erosion problems; (4) to prevent buildup of excessive vegetation that can become a fire hazard in the late summer or complicate snow removal in winter; and most importantly, (5) to ensure highway safety.

Most broadleaf weeds are susceptible to early summer applications of 2,4-D and related herbicides (Classification of Weeds According to Response to Various Foliage Sprays Table). However, many weeds are not effectively controlled by 2,4-D mixtures and these resistant weeds can become an increasing problem unless other herbicides are used. The use of spot treatments with non selective chemicals that may temporarily injure the grass may be justified in some cases to control isolated, but dense, patches of difficult weeds before they spread and become a problem over a large area.

Postemergence Broadleaf Herbicides

2,4-D * 2,4-D (470 g/L)	1.1 kg/ha 2.2 L/ha	 0.9 L/ac	▪ Apply as the **amine** or **low-volatile ester** in 200–300 L/ha water (80–120 L/ac) in early summer. See Table 21 for weed susceptibilities for 2,4-D mixtures.
chlorsulfuron TELAR (75 DF)	53 g/ha 75 g/ha	 30 g/ac	▪ A surfactant should be added to improve control.
clopyralid TRANSLINE (360 g/L)	0.15 to 0.3 kg/ha 0.42 to 0.83 L/ha	 0.17 to 0.33 L/ac	▪ For Canada thistle, perennial sow thistle, spotted knapweed and coltsfoot. ▪ Treat when weeds are young and actively growing. ▪ For coltsfoot, treatments should be performed prior to August. ▪ Apply as a broadcast foliar in 200 L/ha water (80 L/ac) or in sufficient water to ensure thorough coverage of target vegetation. ▪ For spot treatment apply in 800 L and spray weeds to the point of run-off.
dicamba VANQUISH (480 g/L)	0.6 kg/ha 1.25 L/ha	 0.5 L/ac	▪ For leafy and cypress spurge. Apply when weed is actively growing in 100–200 L/ha water (40–80 L/ac).

dicamba VANQUISH (480 g/L)	1.1 kg/ha 2.3 L/ha	0.9 L/ac	• For goldenrod, apply when weed is actively growing in 100–200 L/ha water (40–80 L/ac). • For field bindweed, apply in mid June or when flowering.
dicamba VANQUISH (480 g/L)	1.36 kg/ha 2.83 L/ha	1.13 L/ac	• For Canada thistle and perennial sow-thistle. • Apply sprays in late spring just prior to flowering or apply to regrowth escaping other treatments in summer or fall.
dichlorprop/ 2,4-D DIPHENOPROP BK 700 (679 g/L) ESTAPROP (582 g/L) DICHLORPROP D (582 g/L)	2.375 kg/ha 3.5 L/ha 4 L/ha 4 L/ha	1.4 L/ac 1.6 L/ac 1.6 L/ac	• Apply as the **low-volatile ester** in 200–500 L/ha water (80–200 L/ac) during early summer for most species.
picloram/ 2,4-D TORDON 101 ((1:3.7)305 g/L)	2.14 kg/ha 7 L/ha	2.8 L/ac	• Apply in 200 L/ha water (80 L/ac) during the spring or early summer after growth appears. Use an approved drift control additive or system. • A permit for purchase and use is required.
triclopyr GARLON 4 (480 g/L)	0.48 to 1.92 kg/ha 1 to 4 L/ha	0.4 to 1.6 L/ac	• Apply in 200–300 L/ha water (80–120 L/ac) when weeds are actively growing.
Postemergence Grass and Broadleaf Herbicides			
amitrole AMITROL 240 (231 g/L)	3 to 4 kg/ha 12.5 to 16.5 L/ha	5 to 6.6 L/ac	• For Canada thistle, perennial sow-thistle. • Apply to the point of runoff when the thistles are in the head stage of growth. • Use spot treatments only, since grasses are susceptible to this chemical and may be controlled for up to 1 season.
amitrole AMITROL 240 (231 g/L)	4.5 to 6.75 kg/ha 18.75 to 28 L/ha	7.5 to 11.2 L/ac	• For milkweed, spray to wet in early summer before flowering. • For horsetail, toadflax, and quackgrass. • Spray when horsetail is growing vigorously. • Use spot treatments only, since grasses are susceptible to this chemical and may be controlled for up to 1 season.
glyphosate* glyphosate (360 g/L)	2.52 to 4.32 kg/ha 7 to 12 L/ha	2.8 to 4.8 L/ac	• For milkweed, field bindweed, Canada thistle, perennial sow-thistle. • Apply in 200–300 L/ha water (80–120 L/ac) when the weeds are in the bud to full flower stage. • Use spot treatments only, since grasses are susceptible to this chemical and may be controlled for up to 1 season. • Also see, **Selective Weed Control With Wiper Applicators** section.

Active ingredient TRADE NAME (Formulation)	RATE (active) PRODUCT PER HA	RATE PRODUCT PER ACRE	PRECAUTIONS For more information, see Chapter 4, Notes on Herbicides and Chapter 5, Notes on Adjuvants

Vegetation Control — Long Term Non-selective

CAUTION: These chemicals should not be used to treat areas that are close to gardens, desirable trees, etc. Since these chemicals are non-selective (will kill any plant that they contact), special care must be used in their application. If the area (for example, a driveway) is higher than a nearby lawn, the chemical may wash onto the lawn with the first rain. If trees or shrubs are feeding under the treated areas, the chemical may leach to their roots and cause injury.

It may be desirable to maintain certain areas completely free of vegetation. Usually two problems are involved. First, the existing vegetation must be destroyed, including the destruction of underground stems and roots of perennials. Second, the bare area thus produced must be maintained either by persistent soil active chemicals or by foliage treatment of weed seedlings.

Some chemicals will kill existing vegetation. Others, while excellent for maintaining the bare area, may be used more economically if combined with another chemical to kill existing growth. If a mixed population of weeds is present, combinations of chemicals that will kill the different weed types may be used advantageously.

Uniform coverage with all chemicals is essential. Touch up operations should be expected, as a single treatment will seldom give complete eradication.

It is usually found that two applications of the lower recommended rate (i.e., 5.5–11 kg/ha), depending on the chemical used, spaced 6 to 12 months apart, give better results than 1 single application of the higher recommended rate. This approach also reduces the risk of off-site movement.

The length of weed control obtained will depend on several factors which include rainfall, soil type, weed type and amount of chemical applied. Control is usually maintained longer in heavier soil types, while in sandy soils and gravel areas the length of effective control is much less.

Care should be exercised when selecting a chemical to use on driveways because washing of the chemical onto nearby lawns and gardens may occur. In situations where this may occur it is advisable to use one of the chemicals listed under **Short Term Total Vegetation Control Or Driveways And Patios.**

The following precautions will reduce the risk of off-site movement:

1. Always follow the manufacturers label;
2. Use the lower recommended rate whenever possible;
3. **Do NOT** apply where runoff water may flow onto agricultural land as injury to crops may result;
4. Keep herbicides away from areas where tree roots may extend into the treated area or in locations where the chemical may be washed or moved into contact with their roots (maintain a distance from the tree equal to at least twice the distance from the tree trunk to the dripline);
5. **Do NOT** apply close to ponds, lakes, streams and wetland areas;
6. These products should be applied by properly licenced applicators.

Bare Areas — Non selective control of all vegetation

bromacil HYVAR X-L (240 g/L)	6.16 to 10.8 kg/ha 25.7 to 45 L/ha	 10.3 to 18 L/ac	• Mullein is not adequately controlled by HYVAR X-L.
bromacil/ diuron KROVAR ((1:1)80 DF)	10.8 to 14.4 kg/ha 13.5 to 18 kg/ha	 5.4 to 7.2 kg/ac	
diuron KARMEX (80 DF)	11.2 to 44 kg/ha 14 to 55 kg/ha	 5.6 to 22 kg/ac	• Plantain is not adequately controlled by KARMEX.
hexazinone VELPAR (90 SP)	4.05 to 8.1 kg/ha 4.5 to 9 kg/ha	 1.8 to 3.6 kg/ac	
imazapyr ARSENAL (240 g/L)	0.72 kg/ha 3 L/ha	 1.2 L/ac	• Apply in sufficient water (100 to 550 L/ha (40 to 220 L/ac)) to wet all foliage during periods of active growth.

Vegetation Control — Short Term Non-selective

Foliage Treatment Chemical Mowing

Chemicals offer an alternative to mowing in areas where top kill of low growing vegetation is desired. The chemicals listed below are first applied when the growth is about 15 cm high. Spray to runoff. Tall vegetation is more difficult to kill and can become an unsightly fire hazard when it dies.

amitrole AMITROL 240 (231 g/L) or glyphosate* glyphosate (360 g/L)	4 kg/ha 16.5 L/ha 1.8 to 2.52 kg/ha 5 to 7 L/ha	 6.6 L/ac 2 to 2.8 L/ac	• Apply to actively growing foliage to be effective. • Apply in sufficient water (200–400 L/ha (80–160 L/ac)) to thoroughly wet all foliage. • With AMITROL 240, newly formed leaves turn white before the plants die. The appearance of foliage injury may be delayed during cool conditions. • Regrowth may occur from freshly germinating plants or from underground portions of perennial weeds. (Also see, **Selective Weed Control With Wiper Applicators** section.)
paraquat GRAMOXONE (200 g/L) or diquat REGLONE 240 (240 g/L)	1.1 to 2.2 kg/ha 5.5 to 11 L/ha 0.55 to 1.1 kg/ha 2.3 to 4.6 L/ha	 2.2 to 4.4 L/ac 0.92 to 1.84 L/ac	• Apply at the higher rates and in a high spray volume (1000 L/ha (400 L/ac)) for dense weed growth. • For chemical mowing along roadsides and other areas where a scorch is desired, GRAMOXONE at 5.5 kg/ha will be adequate. • Use 1 L/1000 L of AGRAL 90 as a wetting agent for best results.

Weed Control in Ditches

When ditches on roadsides, or in other locations, contain standing or moving water, herbicides should not be applied to emergent weeds without consulting the Ontario Ministry of the Environment regarding the need for a permit (see **Water Weeds** section). However, such permits are not normally necessary for the application of herbicides to control weeds adjacent to ditches or weeds in ditches when no water is present.

The following precautions should be taken:

1. Spray when ditch or stream contains no flowing water.
2. Avoid spraying directly onto water surface (violates *Pesticides Act*, *Water Resources Act*).
3. Schedule spray programs so that extensive sections of stream bank or ditch bank are not sprayed at 1 time.
4. Work upstream rather than downstream along the stream bank or ditch bank.
5. Ascertain downstream water uses to avoid possible conflict with the rights of other landowners.

Emergents

2,4-D * 2,4-D (470 g/L)	2.25 kg/ha 4.5 L/ac	 1.8 L/ac	• For bulrushes. • Apply as the **low-volatile ester** in 750–1000 L/ha (300–400 L/ac) water.
amitrole AMITROL 240 (231 g/L)	9 to 11 kg/ha 37.5 to 45.75 L/ha	 15 to 18.3 L/ac	• For cattails. • Apply in a minimum of 1000 L/ha (400 L/ac) water from the time cattails are formed until frost.
glyphosate * glyphosate (360 g/L)	2.52 to 4.32 kg/ha 7 to 12 L/ha	 2.8 to 4.8 L/ac	• For cattails. • Apply during mid to late flowering stage (mid July to late August) when cattails are actively growing. • For isolated spots use a 1% solution (1 L product in 100 L water) and spray to wet all foliage but not to the point of runoff.
paraquat GRAMOXONE (200 g/L)	1.1 to 2.2 kg/ha 5.5 to 11 L/ha	 2.2 to 4.4 L/ac	• For bulrushes. • Apply in 750–1000 L/ha (300–400 L/ac) water when the seed heads are forming – usually late July or August.

TABLE 26. Susceptibility of Woody Plants to Various Herbicides and Mixtures as Foliage Sprays

Common Name	2,4-D	2,4-D Dichlorprop (1:1)	2,4-D Dicamba (2:1)	Fosamine ammonium	2,4-D Picloram (3.7:1)	Triclopyr
alder	S-I	S	S	S	S	S
arborvitae	R	R	S		S	
ash	R	S-I	I-R	S-I	I-R	S
barberry, common	I	S		S	S-I	
basswood	R	S	S	S	S	S
beech	R		I	S-I	S	S-I
birch	S	S	S		S	S
blackberry	R		I-R	S	S-I	S
black locust						S
blueberry	S	S	I-R	I	S	S-I
buckthorn	I-R		I-R		S	S
cedar	R	I-R	S		S	
cherry, black, red	S-I	S	S	S-I	S	S-I
cherry, choke	S-I	S	S	S	S	S
cranberry	S					
creeper, virginia	S	S-I	S	S-I	S	
currants, wild	R		S			
dogwood	S-I	S		S	S	S
elderberry	S		S-I		S	S
elm	I	S-I	S	S-I	S	S-I
fir, balsam	R	S-I	S		S	I-R
grape, wild	S	S	S		S	S
hardhack, spirea	I				S	
hawthorn	I-R	S	S-I	S	S	S
hemlock	R				S	
hickory, black, shagbark	R	S-I	S	I		S
honey locust						S-I
honeysuckle	S-I	S	S		S	
ironwood	R	S-I	S		S	S
juniper	R	I-R	S		S-I	
lilac	I-R				S	
locust, black	I				S	
locust, honey	S-I					

TABLE 26. Susceptibility of Woody Plants to Various Herbicides and Mixtures as Foliage Sprays

Common Name	2,4-D	2,4-D Dichlorprop (1:1)	2,4-D Dicamba (2:1)	Fosamine ammonium	2,4-D Picloram (3.7:1)	Triclopyr
maple, Manitoba	S-I	S	S	S-I	S	S
maple, red	R	I-R	I-R	S-I	S	S-I
maple, silver	S-I				S	S
maple, sugar	R	S-I	I-R		S	S
oak, red	I	I-R	S	I-R	S-I	S
oak, white	I	S-I	S-I		S-I	I
oak, bur	R-I		S	I-R	S	
pine	R	S-I	S	I-R	S	I
plum, wild	I	S		S		
poison-ivy	I	S-I	S	I	S	S
poplar, aspen	S	S	S		S	S
prickly-ash	R		S	S		S
raspberry, wild	R	S	I	S		S
redbud rhododendron	R				R	S
rose, wild	R	I	S	S	S	S
sassafras	S-I					S
sheep-laurel	I		S		S-I	S
spruce	R	I-R	S		S-I	R
sumac, poison	S					S
sweet-fern	I		S	S-I		
viburnum	R					S
walnut	S-I				S	
willow	S	S	S	S	S	S

S Susceptible. Adequate control obtained with one application.

I Intermediate. Retreatment is usually needed for adequate control.

R Resistant. Two or more applciations may not be adequate.

CHAPTER 19. WATER WEEDS (AQUATIC PLANTS)

The *Pesticides Act*, Subsection 5(1), provides that: *"no person shall engage in, perform, or offer to perform an extermination except under and in accordance with a licence of a prescribed class...unless exempt under the regulations"*.

Therefore, a specific water exterminator's licence is required by anyone applying a pesticide to water in Ontario (unless exempt). For instance, the user of a herbicide to control aquatic plants in Ontario requires the person holds an Aquatic Vegetation licence. The licensing system ensures that people are educated about the proper storage, handling, and use of pesticides, and their impact on the environment. Furthermore, if the person is in the business of performing exterminations, an Operator's Licence is also required.

A person is exempt from holding an Aquatic Vegetation licence if using a pesticide to treat a water body for aquatic plants and the water body is located wholly within the boundaries of their property. The water body must have **no** direct or indirect outflow, other than by percolation. A full-time employee of the property owner is also exempt from requiring a licence.

Subsection 7(2) of the *Pesticides Act* provides that: *"no person shall perform a water extermination unless the person is the holder of a permit issued by the Director* [under the *Pesticides Act*] *for the water extermination or is exempt under the regulations"*.

Therefore, unless exempt, a **Permit to Purchase a Pesticide and/or Perform a Water Extermination** must be obtained before any aquatic pesticide can be legally purchased or applied into a water body (e.g. ponds, lakes, rivers, ditches, lagoons, catch basins etc) in Ontario, unless exempt under the regulations. Exemptions include:

- A property owner or their full-time employee is not required to obtain a permit to use an aquatic herbicide in a water body, which has no direct or indirect outflow, other than by percolation, located wholly within the boundaries of his or her own property, or an aquatic herbicide in a drainage ditch that at the time of the extermination contains no moving water but must hold a permit in order to purchase the pesticide.
- The holder of a grower certificate (Certified agriculturist) is not required to obtain a permit to purchase or to use an aquatic herbicide in a water body, which has no direct or indirect outflow, other than by percolation, located wholly within the boundaries of his or her own farmland, or an aquatic herbicide in a drainage ditch located wholly within the boundaries of his or her own farmland that at the time of the extermination contains no moving water.
- An Aquatic Vegetation licence holder does **not** require a permit to purchase or to use a pesticide to control aquatic plants in a water body, which has no direct or indirect outflow, other than by percolation, located wholly within the boundaries of his or her own property or to use an aquatic herbicide in a drainage ditch that at the time of the extermination contains no moving water.

A Limited vendor can sell a Schedule 3, 4 or 6 pesticide to a person who is exempt from holding a licence and/or a permit. A person must hold either an Aquatic Vegetation licence, a Grower Certificate or a permit to purchase a Schedule 2 product from a General vendor.

For further information on licensing and permits, contact the Ontario Ministry of the Environment Regional Office in your area.

Active Ingredient TRADE NAME (Formulation)	RATE (active) PRODUCT PER HA	RATE PRODUCT PER ACRE	PRECAUTIONS For more information see Chapter 4 Notes on Herbicides and Chapter 5 Notes on Adjuvants
Algae and Vascular Submergents (e.g., *Chara*, Canada Water Weed, Tapegrass, Coontail, Water milfoil, Bladderwort, Pondweed			
diquat (aquatic) REWARD (240 g/L)	4.4 to 7 kg/ha 18.3 to 29.2 L/ha	7.4 to 11.8 L/ac	▪ Mixed submerged vascular plants in ponds, ditches, lakes, river canals, slow moving or still water. Tape grass and *Chara* are not controlled. ▪ **Do NOT** use treated water for animal consumption or swimming for at least 24 hr. ▪ **Do NOT** use for human consumption or irrigation for at least 5 days. ▪ To avoid oxygen depletion, treat only 1/4 to 1/3 of the area at a time. ▪ Rate depends on water depth ▪ less than 1.5 m — use 18.3 L/ha (7.4 L/ac) ▪ more than 1.5 m — use 25–29.2 L/ha (10.1–11.8 L/ac) ▪ Apply at dusk in mid–late June when plants are young and growing vigorously.

diquat(aquatic) REWARD (240 g/L)	2.2 kg/ha 9.2 L/ha	3.7 L/ac	▪ Eurasian water milfoil in lakes. ▪ Treat when plants are in the very early stage of growth (June). ▪ See REWARD note above.
diuron KARMEX DF 80%	0.5 to 2 ppm diuron or 6.25 kg/ha m to 25 kg/ha m		▪ Apply lower rates for algae, including filamentous algae such as *Chara*, control and higher rates for Bladderwort and Pondweed. ▪ Apply early in season to surface of water using min. 450 L/ha of water and agitate. Calculate ha m = surface area in sq. m X depth in m/10,000. ▪ Treat only a small portion of the pond at one time to avoid oxygen depletion and fish suffocation. ▪ Do not use in domestic water supplies or water bodies producing fish for human consumption ▪ Do not irrigate with treated water for one year. ▪ Do not apply to ponds or irrigation ditches having desirable trees or plants on the perimeter or to areas where there roots may extend, or in locations where the herbicide may be washed or moved in contact with the roots. ▪ Do not drain ponds into areas containing desirable plants. ▪ Not effective in flowing water.
2,4-D (aquatic) AQUA-KLEEN (19% by wt)	110 to 225 kg/ha	44-90 L/ac	▪ Milfoil, Stargrass, Bladderwort, Eelgrass and Coontail. ▪ Do not use within 1 km of any active water intake. ▪ Do not use water from treated area for consumption by humans or livestock or for irrigation of 2,4-D sensitive crops, for at least 60 days after treatment in confined waterbodies. ▪ Treat early in season when plant growth is sparse to avoid oxygen depletion and fish suffocation.
water soluble dyes AQUASHADE (26 %)	195 mL/1000 m^3 750 mL/1000 m^3		▪ Filamentous algae, pond scums. For use in ponds with no outflow. ▪ **Do NOT** apply to water that will be used for drinking or other domestic purposes. ▪ Make application early in the growing season before algae and weed growth develop. Re-apply when the colour of water fades or first new algae growth develops. ▪ Mechanically remove any heavy vegetation before applying AQUASHADE to avoid oxygen depletion and fish suffocation.
Emergents (e.g, Duckweed, Water shield, Water lily, Bulrush, Cattail)			
amitrole AMITROL 240 (231 g/L)	9 to 11 kg/ha 37.5 to 45.75 L/ha	15 to 18.3 L/ac	▪ Cattails in non crop areas (roadsides, fencerows, ditch banks, drainage ditches). ▪ After catkins are fully formed and up to frost. ▪ **Do NOT** disturb sprayed plant. ▪ **Do NOT** apply where water will be used for irrigation, drinking or other domestic uses. ▪ **Do NOT** apply where water is not wholly confined to user's property. ▪ Apply at a spray volume of 1000 L/ha (400 L/ac) water.

Active ingredient TRADE NAME Formulation	RATE active/ PRODUCT PER HA	RATE PRODUCT PER ACRE	PRECAUTIONS For more information see Chapter 4 Notes on Herbicides and Chapter 5 Notes on Adjuvants
2,4-D (aquatic) AQUA-KLEEN (19% by wt)	110 to 225 kg/ha	44 to 90 L/ac	▪ Water lily and, water shield 175–225 kg/ha. ▪ **Do NOT** use within 1 km of any active water intake. ▪ **Do NOT** use water from treated area for consumption by humans or livestock or for irrigation of 2,4-D sensitive crops, for at least 60 days after treatment in confined waterbodies. ▪ Treat early in season when plant growth is sparse to avoid oxygen depletion and fish suffocation.
diuron KARMEX DF (80%)	0.5 to 2 ppm diuron or 6.25 kg/ha m to 25 kg/ha m		▪ Apply higher rates for emergents such as Duckweed. ▪ Apply early in season to surface of water using min. 450 L/ha of water and agitate. Calculate ha m = surface area in sq. m X depth in m/10,000. ▪ Treat only a small portion of the pond at one time to avoid oxygen depletion and fish suffocation. ▪ **Do NOT** use in domestic water supplies or water bodies producing fish for human consumption ▪ **Do NOT** irrigate with treated water for one year. ▪ **Do NOT** apply to ponds or irrigation ditches having desirable trees or plants on the perimeter or to areas where there roots may extend, or in locations where the herbicide may be washed or moved in contact with the roots. ▪ **Do NOT** drain ponds into areas containing desirable plants. ▪ Not effective in flowing water.
Emergents continued			

diquat(aquatic)
REWARD (240 g/L)
	4.4 to 7 kg/ha
	18.3 to 29.2 L/ha
		7.4 to 11.8 L/ac	▪ Duckweed.
			▪ Apply by directed surface spray on foliage.
			▪ Rate depends on water depth
			  ▪ less than 1.5 m — use 18.3 L/ha (7.4 L/ac)
			  ▪ more than 1.5 m — use 25–29.2 L/ha (10.1–11.8 L/ac)
			▪ Use in 1700–2200 L/ha (680–880 L/ac) water.
			▪ See REWARD note in previous section.

paraquat GRAMOXONE (200 g/L)	1.1 to 2.2 kg/ha 5.5 to 11 L/ha	2.2 to 4.4 L/ac	▪ Cattails, bulrushes and emerged grasses. ▪ **Do NOT** use treated water for 7 days for swimming, human or animal consumption. ▪ **Do NOT** use for irrigation for 5 days. ▪ **Do NOT** apply to muddy water or agitate water excessively for 1–2 days after treatment. ▪ Treat cattails and bulrushes when plants are in flower. ▪ Avoid inhalation of spray mist; consult label for appropriate protective clothing. ▪ Apply at a spray volume of 850–1000 L/ha (340–400 L/ac) water.

Herbicides provide temporary control of nuisance aquatic vegetation. Alternate methods such as mechanical removal (Submergents), dredging or substrate alteration (drainage ditches) can provide longer term control. Management techniques for vegetation control in ponds include minimizing nutrient input, dredging excess sediment, logs and other organic debris, decreasing the surface to depth ratio and increasing the rate of pond turnover (flushing). Some aquatic plant and algae life should be accepted and tolerated as a vital component of a healthy ecosystem.

The use of herbicides may be complicated by the use of water by livestock or humans or by the presence of fish. If the water is flowing, the effect of the chemical on plant, animal, or fish life downstream must be considered. Flowing water, by diluting the herbicide, makes control less effective.

Emergent species such as cattails and bulrushes may have to be sprayed for 2 or 3 consecutive years to bring them under complete control. The chemicals for cattails and other emergents are sprayed so as to thoroughly wet all exposed foliage. Paraquat and amitrole are most effective when cattails are coming into head. Consult the manufacturer's directions.

The vegetation also varies widely; species include completely submerged ones such as *Elodea* (*Elodea canadensis* - Canada waterweed) and algae; free floating ones such as water lilies and emergent plants. Many emergents will grow equally as well on the moist shoreline as when their lower stems and roots are in water. Where these emergent species have taken possession of the shoreline, control measures must embrace that area as well as the water.

Chara (Chara stonewort, muskgrass) are a gray green to green plant–like algae, attached to the sediment, or free floating which in dense communities has a very strong musk odour. It is brittle to the touch and will dry to a white powder upon removal from the water. This plant is difficult to control with moderate doses of algaecides and dense communities should be removed mechanically. Tapegrass (wild celery) *(Vallisneria americana)*; found in many recreational lakes, is resistant to all the currently recommended herbicides. It has long rubbery leaves and numerous short roots. Control is possible only by mechanical methods such as pulling.

Diquat (REWARD) provides good control of a wide variety of submergent species including water–milfoil, pondweeds, *Elodea canadensis (*Canada waterweed) and Coontail. This herbicide is not effective against *Chara spp.* (Muskgrass) and *Nitella sp.* Diquat should be applied on cloudy days in late afternoon and care should be taken not to stir up the bottom since turbidity reduces the effectiveness of treatment. Since diquat takes effect rapidly, decomposition of a large plant mass may deplete oxygen levels which can cause fish to suffocate. Thus, in ponds where fish are present and growth is well established, no more than ¼–1/2 of the pond should be treated at one time. Wait two weeks before treating again. The best time to apply these chemicals is late spring while the plants are growing rapidly. Since this is a contact chemical, control is achieved for one season, and repeat treatments must be made annually.

TABLE 27. Habitats and Herbicide Susceptibility of Common Aquatic Plants

	spring-fed pond	dugout	soft water lake*	hard water lake**	wet ditch***	dry ditch****	Mechanical Control	Copper compound (1)	Diquat (2)	Paraquat (3)	Amitrole (4)
Spirogyra spp.	VC	VC	C-I		VC	I		S	R		
Ulothrix spp.	C	VC			VC			S	R		
Mougeotia spp.	C	VC			VC			S	R		
Cladophora spp.	VC	VC	C	VC	VC	VC		S	R		
Chara spp. (Muskgrass)	VC	I	C-I	VC-I	VC	R		S	R		
Nitella spp. (Stonewort)	I	R	VC	R	R	R		S	R		
Sago pondweed (P. pectinatus)	I	C-I		VC				R	S		
Curly-leaf pondweed (P.crispus)	C	VC		VC				R	S		
Bassweed (P.amplifolius)	R	C		C				R	I		
Richardson pondweed (P. richardsonii)				VC-C				R	S-I		
Flat-stemmed pondweed (P. zosteriformis)				C				R	S		
other narrow-leaf pondweed (Potamogeton spp.)	I	C	C	VC-C				R	S		
Eurasian water milfoil (Myriophyllum spicatum)			VC					R	VS		
Native milfoil (M. exalbescens and others)	C		C	VC				R	VS		
Bladderwort (Utricularia vulgaris)		C		C				R	S-I		
Coontail (Ceratophyllum demersum)		C		VC				R	I		
Water stargrass (Heterantheria dubia)				C				R	S-I		
Tape grass (Vallisneria americana)	R	I	C	VC	R	R	M**	R	R	R	R
Water naiad (Najas flexilis)		I		VC				R	S		
Canada water weed (Elodea canadensis)		C		VC				R	I		
Cattails (T. latifolia, T angustifolia)	VC	VC		VC	VC	I-C	M	R	R	I	S-I
Bulrush (Scirpus spp.)			C	VC	C	C	M	R			S-I
Sedge (Carex spp+A42.)			C	C	C	VC	M	R			S-I
Bur reed (Sparganium spp.)	C		C	C	C	VC	M	R			I
Water plantain (Alisma spp.)			I	C	C	VC		R			S
Pipewort (Eriocaulon spp.)	R	R	C	R	R	R	M*	R		S	

TABLE 27: Habitats and Herbicide Susceptibility of Common Aquatic Plants

	spring-fed pond	dugout	soft water lake*	hard water lake**	wet ditch***	dry ditch****	Mechanical Control	Copper compound (1)	Diquat (2)	Paraquat (3)	Amitrole (4)
Arrowhead (Sagittaria spp.)		C		VC	I-C			R		S	
Pickerelweed (Pontederia spp.)			VC		I	R		R		S-I	
Water smartweed (Polygonium amphibium)	I	I						R		S-I	
Water shield (Brasenia spp.)			C					R		S-I	
White water lily (Nymphaea spp.)			C	C			M*	R		I	
Yellow water lily (Nuphar spp.)		C-I	C	C			M*	R		I	
Duckweed (Lemna spp.)	R	C	I-R	VC				R	S	S	
Duckmeal (Wolffia spp.)	R	C-I	I-R	VC				R	S	S	

VC — very common; C — common; I — infrequent; R — rare

M — manual or mechanical methods equally as effective as herbicides

M* — manual or mechanical methods are generally more effective than herbicides

M** — manual or mechanical methods are the only control measure currently available

S — susceptible; I — Intemediate; R — resistant

Bur reed is also very common as a submerged plant in ecotypes C and D

* A typical Muskoka lake is an example of a soft water lake

** A typical Kawartha lake is an example of a hard water lake

*** A wet ditch contains water at time of treatment

**** A dry ditch contains no water at time of treatment

(1) Copper compound (Cutrine Plus)

(2) Diquat (Reglone A)

(3) Paraquat (Gramoxone)

(4) Amitrole (Amitrole 240)

TABLE 28 Classification of Weeds According To Response to Various Foliage Sprays

Common Name	2,4-D	MCPA	2,4-DB or MCPB	Mecoprop	Dicamba
aster (perennial)	I				
bedstraw (perennial)	R	I-R	R	I	R
bellflower (perennial)	R				
bindweed, field (perennial)	I	I	I	I	S-I
blueweed (biennial)	S-I	I		I	I
bracken fern (perennial)	R	R	R	R	I
buckwheat, wild (annual)	I-R	I	I-R	I-R	S
burdock (biennial)	S	S	I		S
buttercup (perennial)	I-R	S-I	I**(I-R)	I	I
campion, bladder (perennial)	R	R	R	R	
carrot, wild (biennial)	S-R	S-R	R	I-R	S
catchfly, night-flowering (annual)	R	R	R	R	
catnip (perennial)	S-I				
chickweed, common (annual)	I-R	I	R	S	S
chickweed, mouse-eared (perennial)	I-R	I-R	R	S	S
chicory (perennial)	S	S-I	S-I*(R)	I-R	S
cinquefoil, rough (winter annual)	I				
cinquefoil, sulphur (upright c.), (perennial)	I				
cocklebur (annual)	S	S	S	S	S
cockle, purple (annual)	I-R	R	R		I
cockle, white (perennial)	R		I-R		I
daisy, ox-eye (perennial)	I	I	R	I	I
dandelion (perennial)	S	S	I*(R)	I	S
dock (perennial)	I	I	I	I	
evening-primrose (biennial)	S				
false flax (winter annual)	S	S	S	S	S
fleabane, annual (daisy f.) (winter annual)	I	I	S-I		
fleabane, Canada (annual)	S-I				
goat's-beard (biennial)	I				
golden rod (perennial)	I	R	I	I	
goosefoot (annual)	S	S	S	S	
goutweed (perennial)	R	R	R	R	
grasses (annual and perennial)	R	R	R	R	
ground-ivy (Creeping Charlie) (perennial)	I-R	I-R		I	S
groundsel (annual)	I	I			

TABLE 28. Classification of Weeds According To Response to Various Foliage Sprays

Common Name	2,4-D	MCPA	2,4-DB or MCPB	Mecoprop	Dicamba
hawkweed (perennial)	I-R	I-R			S-I
heal-all (perennial)	I-R	I-R	I-R	S	S
hemp-nettle (annual)	R	S-I	I-R**(R)	R	
horse-nettle (perennial)	R				I
horse-tail (perennial)	I-R	S-I	I-R	I-R	I
knapweeds (perennial)	R		I*(I-R)		I
knotweed (annual)	I-R		I-R*(R)	S-I	S
lady's thumb (annual)	S-I	I-R	S	I-R	S
lamb's-quarters (annual)	S	S	S	S	S
lettuce, prickly (annual)	S-I	S	I-R	S	
mallow, round-leaved (perennial)	I-R	I-R	R	I-R	
mayweed (annual)	I-R		I		S
medick, black (winter annual)	I	I		S	I
milkweed (perennial)	R	R	R	I-R	I-R
motherwort (perennial)	S-I				
mullein (biennial)	I-R				
mustards (annual)	S	S	I	S	
nightshade (perennial)	I-R			R	
parsnip, wild (biennial)	S				
pepper-grass, common (winter annual)	S	S-I	I		
pepper-grass, field (winter annual)	S	S	I		
pigweeds (annual)	S	I	S-I	S	S
pineappleweed (annual)	S		R	R	
plantains (perennial)	S	S	S-I	S-I	I
purslane (annual)	I	I	S-I	S-I	
ragweed (annual)	S	S	S	S	S
ragwort (biennial and perennial)	I-R	R	R	I	S-I
ribgrass (see plantains) (perennial)					
rocket, yellow (biennial)	S	I	I*(R)		
shepherd's purse (winter annual)	S-I	S	S-I	S-I	
smartweed, green (annual)	S-I	I-R	I-R	I-R	S
sorel, sheep (perennial)	I	R			
sow-thistle, annual (annual)	S	I	S-I	I	S-I
sow-thistle, perennial (perennial)	I	R	S-I*(I-R)		S-I
speedwells (annual and perennial)	I-R	I-R		S-I	I
spurge, cypress (perennial)	I-R	I-R	I-R		I

TABLE 28 Classification of Weeds According To Response to Various Foliage Sprays

Common Name	2,4-D	MCPA	2,4-DB or MCPB	Mecoprop	Dicamba
spurge, leafy (perennial)	I-R	I-R	I-R	R	S
spurry, corn (annual)	R	I	R	I	R
St. John's wort (perennial)	R	R	R	R	S
stinkweed (pennycress) (winter annual)	S	S	S-I	S-I	
stonecrop, mossy (perennial)	I	I		S-I	
teasel (biennial)	S				
thistle, bull (biennial)	S	S	S	S	S-I
thistle, Canada (perennial)	I	I	I	I	
thistle, nodding (biennial)	I		I		S-I
thistle, Russian (annual)	S-I		I-R	R	
toadflax (perennial)	R	R	R	R	S-I
velvetleaf (annual)	S-I	I	S-I*(I-R)		I
vetch (perennial)	I-R	I-R	R	I-R	I
vetches, wild (annual)	S	S			
violet, field (field pansy) (annual)	R			R	
water-hemlock (perennial)	S-I				
wood-sorrel (perennial)	I-R				
yarrow (perennial)	R	I-R		I-R	I-R

* 2,4-DB more effective (susceptibility to MCPB in brackets)

** MCPB more effective (susceptibility to 2,4-DB in brackets)

S — Susceptible. Killed by 1 application of 2,4-D, MCPA or Mecoprop (1.2 kg or less per ha); or by 1 application of dicamba (425 g or less per ha).

I — Intermediate. Killed less rapidly but controlled by higher rates or by repeated applications.

R — Resistant. Not affected or only slightly damaged by chemical treatment. Control of this weed is not practical with herbicide(s) listed at the top of this column.

APPENDIX A. CONTRIBUTORS TO GUIDE TO WEED CONTROL 2002

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APPENDIX B. WEED CONTROL GLOSSARY

Acid Equivalent (abbreviation - a.e.) (2,4-D, glyphosate) — the active part of the acid herbicide being used — usually indicated in grams/L on the label.

Active Ingredient — the chemical in a formulated product that is responsible for the herbicide effects.

Adjuvant — an ingredient added to a herbicide formulation or spray mixture to aid or modify the action of the herbicide, or the physical characteristics of the mixture.

Amine — acid or anionic herbicides can be formulated as ammonium salts or amines. 2,4-D amines are relatively non-volatile under most climatic conditions.

Annual Plant — completes its life cycle within a one year period. Summer annuals complete their life cycle between spring and fall. Winter annuals germinate in fall, overwinter and then flower and complete their life cycle the following spring or summer.

Band Treatment — a herbicide applied as a narrow strip over the crop row, usually followed by inter-row cultivation.

Biennial Plant — completes its life cycle within a two-year period. Germinates in the spring, overwinters, flowers the following spring or summer and dies back the following fall.

Carrier — the diluent or material added to a herbicide product to facilitate its even distribution over the target area. The carrier is often water but it may also be granular products, oil or other solvents.

Compatible — compounds or formulations that can be mixed and applied together without undesirably altering their separate effects effects or the physical properties of the mixture.

Contact Chemicals — chemicals that kill only the parts of the plant on which they are sprayed. Movement within the plant is minimal.

Cotyledons — the seed leaves. Often visible when large seeds are opened. These are the first leaves visible in the germinated seedling. Broad-leaved crops or weeds have two cotyledons(dicots). Grasses (monocots) have one.

Directed Treatment — a treatment directed onto the weeds or soil in such a manner as to avoid contact with the crop.

Dormant — a resting stage similar to the condition of a plant during the winter.

Emergence — the time at which the seedling first appears above the ground.

Escape — a plant in a treated area that has been missed or survived the treatment.

Ester — Some acid herbicides are reacted with alcohols to produce ester formulations. Ester formulations of 2,4-D and related herbicides can vaporize under hot conditions after treatment and cause unwanted damage by moving away from the treated area.

Formulation — means the same as Product — an active ingredient processed with other materials or formulants to make it easier to apply and/or more effective. Herbicides are rarely sold as pure active ingredients(2,4-D acid), they are sold as formulated mixtures(i.e. 2,4-D amine, sodium salt or ester with added emulsifiers, adjuvants, carriers, etc.).

Half-life — the time required for 50% of a herbicide to be degraded or inactivated in soil or water.

Herbicide — a chemical that is toxic to plants.

Herbicide Tolerant Crops (abbreviation - HTCs) — New varieties of crops that have been developed by classical breeding or transgenic techniques to be tolerant to specific herbicides

Hormone-Type Herbicide — includes 2,4-D, 2,4-DB, mecoprop MCPA, MCPB, dichlorprop, dicamba and triclopyr, picloram. At extremely low concentrations, these chemicals can stimulate and/or disrupt the growth of broadleaved plants.

Non-Selective Herbicide — a chemical used in such a manner that all exposed vegetation is damaged.

Perennial Plant — lives for more than 2 years.

Product — the contents of a herbicide container as marketed. In addition to the active ingredient, it may also contain other solvents, surfactants or carriers that are referred to as inert ingredients or formulants.

Program — application of one or more herbicides at two different stages of crop and/or weed growth. The second herbicide application is used to provide control of the weeds either escaping the original herbicide treatment or that are problems at different periods in the growth of the crop.

Resistant Weeds (Herbicide Resistant Weeds) — the inherited ability of some weeds in the population of a particular weed species to survive a herbicide application to which most of the original population was susceptible.

Selective Herbicide — a chemical used in such a manner that it will kill weeds on a growing crop without damaging the crop.

Sodium Salt — some acid or anionic herbicides can be formulated as sodium salts (e.g. 2,4,-D).

Soil Sterilant — a soil active herbicide that is applied at a sufficiently high rate to prevent all plant growth for at least one season

Surfactant — a chemical added to the herbicide formulation or to the spray solution to improve the dispersing, spreading, sticking or wetting properties of the spray mixture.

Susceptible — a crop that may be damaged or a weed that may be readily controlled by a recommended rate of herbicide.

Tank-Mix — two chemicals that are packaged separately and mixed in the sprayer tank.

Translocated Herbicide — a chemical herbicide that moves within the plan

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Fergus Resource Centre RR#1, County Road 18, Wellington Place Fergus, ON N1M 2W3	**Phone: (519) 846-0941** **Fax: (519) 846-8178**		
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Harrow Greenhouse and Processing Crops Research Centre 2585 County Road 20, Harrow, ON N0R 1G0	**Phone (519) 738-2251** **Fax (519) 738-4564**		
Greenhouse Vegetable IPM Specialist	Gillian Ferguson	gillian.ferguson@omafra.gov.on.ca	(519) 738-2251 Ext. 406
Weed Management —Horticulture Program Lead	Leslie Huffman	leslie.huffman@omafra.gov.on.ca	(519) 738-2251 Ext. 499
Greenhouse Vegetable Specialist	Shalin Khosla	shalin.khosla@omafra.gov.on.ca	(519) 738-2251 Ext. 405
Kemptville Resource Centre Box 2004, Concession Rd Kemptville, ON K0G 1J0	**Phone: (613) 258-8295** **Fax: (613) 258-8392**		
Emerging Crops Specialist	Scott Banks	scott.banks@omafra.gov.on.ca	(613) 258-8359
Agroforestry Specialist	Dave Chapeskie	dave.chapeskie@omafra.gov.on.ca	(613) 258-8302
Field Crops, IPM Program Lead — Bilingual	Gilles Quesnel	gilles.quesnel@omafra.gov.on.ca	(613) 258-8250
Lindsay Resource Centre 322 Kent St. W Lindsay, ON K9V 2Z9	**Phone: (705) 324-6125** **Fax: (705) 324-1638**		
Forage Specialist	Joel Bagg	joel.bagg@omafra.gov.on.ca	(705) 324-5856
London Resource Centre 667 Exeter Road London, ON N6E 1L3	**Phone: (519) 873-4070** **Fax: (519) 873-4062**		
Horticulture Systems Specialist	John Gardner	john.gardner@omafra.gov.on.ca	(519) 873-4084
New Liskeard 280 Armstrong St. Box 4070, New Liskeard, ON P0J 1P0	**Phone: (800) 461-6132** **Fax: (705) 647-7993**		
Agriculture and Rural Representative	Daniel Tasse	daniel.tasse@omafra.gov.on.ca	(705) 647-2085

Ridgetown Resource Centre Agronomy Building, Ridgetown College Box 400, Main St. E Ridgetown, ON N0P 2C0	**Phone (519) 674-1690** **Fax (519) 674-1564**		
Soil Management Specialist — Field Crops	Adam Hayes	adam.hayes@omafra.gov.on.ca	(519) 674-1621
Pathologist — Field Crops Program Lead	Albert Tenuta	albert.tenuta@omafra.gov.on.ca	(519) 674-1617
IPM Modelling Specialist	Heather Griffiths	heather.griffiths@omafra.gov.on.ca	(519) 674-1694
Vegetable Crops Specialist	Anne Verhallen	anne.verhallen@omafra.gov.on.ca	(519) 674-1614
Vegetable Crops Specialist	Janice LeBoeuf	janice.leboeuf@omafra.gov.on.ca	(519) 674-1699
Entomology, Field Crops Program Lead	Tracey Baute	tracey.baute@omafra.gov.on.ca	(519) 674-1696
Simcoe Resource Centre P.O. Box 587, Blueline Rd & Hwy #3 Simcoe, ON N3Y 4N5	**Phone: (519) 426-7120** **Fax: (519) 426-1142**		
New Crop Development Specialist	Mike Columbus	mike.columbus@omafra.gov.on.ca	(519) 426-4509
Berry Crop Specialist	Pam Fisher	pam.fisher@omafra.gov.on.ca	(519) 426-2238
Sprayer Application Technology Specialist	*Vacant		
Ginseng and Medicinal Herbs Specialist	Jan Schooley	jan.schooley@omafra.gov.on.ca	(519) 426-4323
Pome Fruit IPM Specialist (Acting)	Kathryn Carter	kathryn.carter@omafra.gov.on.ca	(519) 426-4322
IPM Specialist — Specialty Crops	Denise Beaton (on leave)	denise.beaton@omafra.gov.on.ca	(519) 582-7220 ext. 263
Stratford Resource Centre 581 Huron St. Stratford, ON N5A 5T8	**Phone (519) 271-0280** Fax (519) 273-5278		
Alternate Production Systems Specialist	Brian Hall	brian.hall@omafra.gov.on.ca	(519) 271-0083
Cereals Specialist	Peter Johnson	peter.johnson@omafra.gov.on.ca	(519) 271-8180
Biosolids Specialist	Michael Payne	michael.payne@omafra.gov.on.ca	(519) 271-4496
Soil Fertility Specialist	Keith Reid	keith.reid@omafra.gov.on.ca	(519) 271-9269
Soybeans and Edible Beans Specialist	Horst Bohner	horst.bohner@omafra.gov.on.ca	(519) 271-5858
Thunder Bay 335 Euclid Ave., Thunder Bay, ON P7E 6G6	**Phone: (807) 475-1373** **Fax: (807) 475-1219**		
Research Coordinator Northwestern Ontario	Gordon Scheifele	gordon.scheifele@omafra.gov.on.ca	(807) 475-1373
Vineland — HRIO, University of Guelph Box 7000, 4890 Victoria Ave. N Vineland Station L0R 2E0	**Phone: (905) 562-4141** **Fax: (905) 562-3413**		
Greenhouse Floriculture Specialist	Wayne Brown	wayne.brown@omafra.gov.on.ca	(905) 562-4141 Ext. 179
Greenhouse Floriculture IPM Specialist	Graeme Murphy	graeme.murphy@omafra.gov.on.ca	(905) 562-4141 Ext. 106

Vineland Resource Centre **Adv. Serv. Building, Box 8000,** **4890 Victoria Avenue, N** **Vineland Station, ON L0R 2E0**	**Phone (905) 562-4147** **Fax (905) 562-5933**		
Tender Fruit and Grape Specialist	Ken Slingerland	ken.slingerland@omafra.gov.on.ca	(905) 562-1639
Nutrient Management Horticulture Crops Program Lead	Donna Speranzini	donna.speranzini@omafra.gov.on.ca	(905) 562-1170
Entomology, Horticulture Program Lead	Hannah Fraser	hannah.fraser@omafra.gov.on.ca	(905) 562-1674
Fresh Market Quality Program Lead	Dr. Jennifer R. DeEll	jennifer.deell@omafra.gov.on.ca	(905) 562-1693
Tender Fruit and Grape IPM Specialist	Neil Carter	neil.carter@omafra.gov.on.ca	(905) 562-3833
Woodstock Resource Centre **Box 668, Hwy. #59 N** **Woodstock, ON N4S 7Z5**	**Phone (519) 537-6621** **Fax (519) 539-5351**		
Nutrient Management Field Crops Program Lead	Christine Brown	christine.brown@omafra.gov.on.ca	(519) 537-8305
Guelph OMAFRA **1 Stone Road West** **Guelph, ON N1G 4Y2**	**Fax: (519) 826-3567**		
Director Crop Technology	Bill Ingratta	bill.ingratta@omafra.gov.on.ca	(519) 826-3151 Fax (519) 826-3567
Manager, Greenhouse, Agroforestry and Specialty Crops	Annette Anderson	annette.anderson@omafra.gov.on.ca	(519) 826-3286 Fax (519) 826-3567
Manager, Horticulture Technology	Hugh Berges	hugh.berges@omafra.gov.on.ca	(519) 826-3288 Fax (519) 826-3567
Manager, Horticulture Crops	John Finlay	john.finlay@omafra.gov.on.ca	(519) 826-6941 Fax (519) 826-3567
Manager, Field Crops	Brent Kennedy	brent.kennedy@omafra.gov.on.ca	(519) 826-3257 Fax (519) 826-3567
Marketing and Communications Officer	Cathy Wilson Pinkney	cathy.wilsonpinkney@omafra.gov.on.ca	(519) 826-3150 Fax (519) 826-3259
Crop Protection Program Lead	Craig Hunter (currently on assignment)	craig.hunter@omafra.gov.on.ca	(519) 826-4189 Fax (519) 826-3259
Apiary Specialist	Doug McRory	doug.mcrory@omafra.gov.on.ca	(519) 826-3595 Fax (519) 826-3259
Product Development Specialist	Kelly Ward	kelly.ward@omafra.gov.on.ca	(519) 826-4094 Fax (519) 826-4964
Vegetable Crops Specialist	Kristen Callow	kirsten.callow@omafra.gov.on.ca	(519) 826-4963 Fax (519) 826-4964
On-Farm Food Safety Program Lead	Sandra Jones	sandra.jones@omafra.gov.on.ca	(519) 826-3289 Fax (519) 826-4964
Applied Research Coordinator – Horticulture	*Vacant		
Organic Crop Production Program Lead	Hugh Martin	hugh.martin@omafra.gov.on.ca	(519) 826-4587 Fax (519) 826-4964
Minor Use Coordinator	Jim Chaput	jim.chaput@omafra.gov.on.ca	(519) 826-3539 Fax (519) 826-4964

University of Guelph **50 Stone Road East** **Guelph, ON N1G 2W1**	**Phone (519) 824-4120**		
Turgrass Specialist Guelph Turfgrass Institute 328 Victoria Rd. S., R.R. #2, Guelph ON N1H 6H8	Pam Charbonneau		(519) 824-4120 Ext. 2597 Fax (519) 766-1704
Potato Specialist, Food Science Building	Dr. Eugenia Banks	eugenia.banks@omafra.gov.on.ca	(519) 824-4120 Ext. 2673 Fax (519) 824-6631
Pathologist – Horticulture Crops Program Lead Edmund Bovey Building	Michael Celetti	michael.celetti@omafra.gov.on.ca	(519) 824-4120 Ext. 8910 Fax (519) 767-0755
Nursery Crops Specialist, Edmund Bovey Building	Jennifer Llewellyn	jennifer.llewellyn@omafra.gov.on.ca	(519) 824-4120 Ext. 2671 Fax (519) 767-0755
Nutrition — Horticulture Program Lead Land Resource Science, Richards Building	Christoph Kessel	christoph.kessel@omafra.gov.on.ca	(519) 824-4120 Ext. 2480 Fax (519) 824-5730
Weed Management Field Crops Program Lead Crop Science Building	*Vacant		
Applied Research Coordinator — Field Crops Crop Science Building	Ian McDonald	ian.mcdonald@omafra.gov.on.ca	(519) 824-4120 Ext. 6707 Fax (519) 763-8933
Corn Industry Program Lead Crop Science Building	Greg Stewart	greg.stewart@omafra.gov.on.ca	(519) 824-4120 Ext. 4865 Fax (519) 763-8933

APPENDIX D. MINISTRY OF THE ENVIRONMENT PESTICIDE CONTROL OFFICES

REGION County	PESTICIDES OFFICER Address	Telephone
Central Region Toronto, Halton, Peel York, Durham	Charles Zubovits 5775 Yonge St, 8th Floor Toronto, Ontario M2M 4J1	(416) 326-3671 Toll Free 1-800-810-8048 Fax (416) 325-6347
West-Central Region Haldimand-Norfolk, Niagara, Hamilton-Wentworth, Dufferin, Wellington, Waterloo, Brant	Paul McCubbin Ontario Government Building 119 King St. West, 12th Floor Hamilton, Ontario L8P 4Y7	(905) 521-7667 Fax (905) 521-7820
Eastern Region Frontenac, Hastings, Lennox & Addington, Prince Edward, Leeds & Grenville, Prescott & Russell, Stormont/Dundas & Glengarry , Haliburton, Peterborough, Victoria, Northumberland, Renfrew, Ottawa-Carleton, Lanark, District of Nipissing (Twsps of Airy, Murchison, Dickens, Lyell and Sabine)	Roberto Sacilotto Laurel Grills 133 Dalton Avenue P.O. Box 820 Kingston, Ontario K7L 4X6	(613) 549-5047 Fax (613) 548-6908 Toll Free 1-800-267-0974
Southwestern Region Elgin, Middlesex, Oxford, Essex, Kent, Lambton, Bruce, Grey, Huron, Perth,Simcoe	Gary Roberts Wray Lampman 695 Exeter Road, 2nd Floor London, Ontario N6E 1L3	(519) 873-5041 (519) 873-5048 Fax (519) 873-5020
Northern Region Manitoulin, Nipissing, Parry Sound, Sudbury, Algoma East, Cochrane East, Muskoka	John Negusanti 199 Larch Street, Ste 1101 Sudbury, Ontario P3E 5P9	(705) 564-3249 Fax (705) 564-4180
Kenora, Rainy River, Thunder Bay, Algoma West, Cochrane West, Timmins	Don Mitchell 435 James St. S., Suite 331 Thunder Bay, Ontario P7E 6S7	(807) 475-1712 Fax (807) 475-1745
Standards Development Branch	Pesticides Section 40 St. Clair Avenue West, 7th Floor Toronto, Ontario M4V 1M2	(416) 327-5519 Fax (416) 327-2936
Approvals Branch	Pesticides Licensing 2 St. Clair Avenue West, 12A Floor Toronto, Ontario M4V 1L5	(416) 314-8001 Fax (416) 314-8452

APPENDIX E. OTHER CONTACTS

UNIVERSITY OF GUELPH

Main Campus, Guelph, N1G 2W1
(519) 824-4120
www.uoguelph.ca

Alfred College, Alfred, K0B 1A0
(613) 679-2218
www.alfredc.uoguelph.ca/

Kemptville College, Kemptville, K0G 1J0
(613) 258-8336
www.kemptvillec.uoguelph.ca

Ridgetown College, **Ridgetown, N0P 2C0**
(519) 674-1500
www.ridgetownc.on.ca

Department of Plant Agriculture
www.plant.uoguelph.ca

Department of Plant Agriculture, Kettleby
1125 Woodchopper's Lane, R.R. # 1,
Kettleby, L0G 1J0
(905) 775-3783

Department of Plant Agriculture, Simcoe
Box 587 Blue Line Rd., Simcoe, N3Y 4N5,
(519) 426-7127

Department of Plant Agriculture, Vineland
Box 7000, 4890 Victoria Ave. N.,
Vineland Station, L0R 2E0
(905) 562-4141

Lab Services Division

www.uoguelph.ca/labserv/
Pesticide and Trace Contaminants, P.O. Box 3650,
95 Stone Road, West, Guelph, N1H 8J7
(519) 767-6200

Pest Diagnostic Clinic
(519) 767-6256

AGRICULTURE & AGRI-FOOD CANADA

Research Centres

Eastern Cereals and Oilseeds Research Centre,
960 Carling Avenue, Ottawa, K1A 0C6
(613) 759-1952
http://res2.agr.ca/ecorc/welcome.htm

Greenhouse and Processing Crops Research Centre, Harrow N0R 1G0
(519) 738-2251
http://res2.agr.ca/harrow/

Southern Crop Protection and Food Research Centre
http://res2.agr.ca/london/pmrc/pmrchome.html

- 1391 Sandford St., London N5V 4T3
  (519) 457-1470
- Vineland Research Farm
  4902 Victoria Ave. N., Vineland
  (905) 562-4113
- Delhi Research Farm
  Box 186 Schafer Rd., Delhi N4B 2W9
  (519) 582-1950

CANADIAN FOOD INSPECTION AGENCY

www.cfia-acia.agr.ca

Regional Offices (Plant Protection)

Belleville
345 College Street East, Belleville, K8N 5S7
(613) 969-3333

Hamilton
709 Main St. W. 101, Hamilton, L8S 1A2
(905) 572-4152

London
457 Richmond St., Suite 404, London, N6A 3E3
(519) 645-4021

Niagara Falls

(Mail address) R.R #1 P.O. Box #7,
Niagara on the Lake, L0S 1J0

(Street address) 14154 Niagara River Parkway,
Unit # 5., Niagara On the Lake
(905) 262-5331

Brantford
Federal Building, Dalhousie & Queen St, P.O. Box 637, Brantford, N3T 5P9
(519) 751-8157

Ottawa District
3 Observatory Crescent, Bldg., #3 Central,
Experimental Farm, Ottawa, K1A 0C9
(613) 759-1571

Toronto Office
401 Champagne Drive, Unit 1, Downsview, M3J 2C6,
(416) 954-1714

Windsor
441 University Ave. W., Suite 208, Windsor. N9A 5P9
(519) 252-7095

APPENDIX F. DIAGNOSTIC SERVICES

Samples for disease diagnosis, insect or weed identification, nematodes counts and Verticillium testing can be sent to:

Pest Diagnostic Clinic
Laboratory Services Division
University of Guelph
95 Stone Rd. W.,
GUELPH, Ont., N1H 8J7
Telephone (519) 767-6256
Fax (519) 767-6240
E-mail: *pdc@lsd.uoguelph.ca*

Payment must accompany samples at the time of submission.

SUBMISSION FORMS ARE AVAILABLE AT:
www.uoguelph.ca/pdc

Fee Schedule

Procedures	Price/Sample
Plant Diseases	
Diagnosis not requiring planting	$25
Diagnosis requiring planting	$40
Turf Diagnosis	$50
Bacterial Identification using Biolog â	$95
Detection of virus using Transmission Electron Microscopy	$85
Detection of virus using ELISA (turn around time = 5 working days, bulk rates available)	$60
Weed Identification	$40
Insects	
Basic identification	$25
Identification requiring dissection and/or extensive keys	$40

Nematode & Verticillium Counts	Price/ Sample
Nematodes extracted from soil (Bearman Pan Method)	$25
Soybean Cyst Nematode & Egg Count	$35
Nematodes extracted from roots	$60
Verticillium count	$60
Turn around time:	
Nematodes extracted from soil — 7 or 8 days	
Nematodes extracted from roots — 15 days	
Cyst counts — 3 or 4 days	

Charges will be applied to each sample submitted.
Payment: Please make cheque payable to the University of Guelph. VISA and Mastercard are also accepted. Please do not mail cash.

Submitting Plant for Disease Diagnosis or Identification

Sample Submission Forms

Carefully fill in all of the categories on the form. In the space provided draw the most obvious symptom and the pattern of the disease in the field. It is important to include the cropping history of the area for the past 3 years and this year's pesticide use records.

Choose a complete, representative sample showing early symptoms. Submit as much of the plant as is practical, including the root system, or several plants showing a range of symptoms. For turfgrass, submit a 10–15 cm, square piece of turf, including thatch and at least 5 cm of soil. The sample should be taken from the outside edge of a ring or patch and include healthy and unhealthy turf and the interface between. If symptoms are general, collect the sample from an area where they are of intermediate severity. **Completely dead material is usually inadequate for diagnosis.** Plant specimens submitted for identification should at least include a 20–25 cm sample of the top portion of the stem with lateral buds, leaves, flowers or fruits in identifiable condition. Wrap plants in newspaper and put in a plastic bag. Tie the root system off in a separate plastic bag to avoid drying out and soil contaminating the leaves. Do NOT add moisture, as this encourages decay in transit. Cushion specimens and pack in a sturdy box to avoid damage during shipping. Avoid leaving specimens to bake or freeze in a vehicle or in a location where they could deteriorate.

Delivery to the Pest Diagnostic Clinic should be made as soon as possible by first class mail or by courier at the beginning of the week.

APPENDIX G. METRIC CONVERSIONS

Linear Measures (length)

10 millimetres (mm)	= 1 centimetre (cm)
100 centimetres (cm)	= 1 metre (m)
1000 metres	= 1 kilometre (km)

Square Measures (area)

100 m X 100 m = 10,000 m^2	= 1 hectare (ha)
100 ha	= 1 square kilometre (km^2)

Cubic Measures (volume)

Dry Measures

1000 cubic millimetres (mm^3)	= 1 cubic centimetre (cm^3)
1,000,000 cm^3	= 1 cubic metre (m^3)

Liquid Measures

1000 millilitres (mL)	= 1 litre (L)
100 L	= 1 hectolitre (hL)

Weight-Volume Equivalents (for water)

(1.00 kg) 1000 grams	= 1 litre (1.00 L)
(0.50 kg) 500 g	= 500 mL (0.50 L)
(0.10 kg) 100 g	= 100 mL (0.10 L)
(0.01 kg) 10 g	= 10 mL (0.01 L)
(0.001 kg) 1 g	= 1 mL (0.001 L)

Weight Measures

1000 milligrams (mg)	= 1 gram (g)
1000 g	= 1 kilogram (kg)
1000 kg	= 1 tonne (t)
1 mg/kg	= 1 part per million (ppm)

Dry – Liquid Equivalents

1 cm^3	= 1 mL
1 m^3	= 1000 L

Application Rate Conversions

Metric to Imperial (Approximate)

litres per hectare x 0.09	= gallons per acre
litres per hectare x 0.36	= quarts per acre
litres per hectare x 0.71	= pints per acre
millilitres per hectare x 0.015	= fluid ounces per acre
grams per hectare x 0.015	= ounces per acre
kilograms per hectare x 0.89	= pounds per acre
tonnes per hectare x 0.45	= tons per acre

Imperial to Metric (Approximate)

gallons per acre x 11.23	= litres per hectare (L/ha)
quarts per acre x 2.8	= litres per hectare (L/ha)
pints per acre x 1.4	= litres per hectare (L/ha)
fluid ounces per acre x 70	= millitres per hectare (mL/ha)
tons per acre x 2.24	= tonnes per hectare (t/ha)
pounds per acre x 1.12	= kilograms per hectare (kg/ha)
ounces per acre x 70	= grams per hectare (g/ha)

Dry Weight Equivalents

Grams or Kilograms per Hectare	*Ounces or Pounds per Acre*
100 grams	= 1 1/2 ounces
200 grams	= 3 ounces
300 grams	= 4 1/4 ounces
500 grams	= 7 ounces
700 grams	= 10 ounces
1.10 kilograms	= 1 pound
1.50 kilograms	= 1 1/4 pounds
2.00 kilograms	= 1 3/4 pounds
2.50 kilograms	= 2 1/4 pounds
3.25 kilograms	= 3 pounds
4.00 kilograms	= 3 1/2 pounds
5.00 kilograms	= 4 1/2 pounds
6.00 kilograms	= 5 1/4 pounds
7.50 kilograms	= 6 3/4 pounds
9.00 kilograms	= 8 pounds
11.00 kilograms	= 10 pounds
13.00 kilograms	= 11 1/2 pounds

Metric Conversions

5 mL	=1 tsp
15 mL	= 1 tbsp
28.5 mL	= 1 fl. oz.

Liquid Equivalents

Litres/ Hectare	*Approximate Gallons/Acre*
50	= 5
100	= 10
150	= 15
200	= 20
250	= 25
300	= 30

CONVERSION TABLES — Metric to Imperial

Length

1 millimetre (mm)	= 0.04 inch
1 centimetre (cm)	= 0.40 inch
1 metre (m)	= 39.40 inches
1 metre (m)	= 3.28 feet
1 metre (m)	= 1.09 yards
1 kilometre (km)	= 0.62 mile

Volume (liquid)

1 millilitre (mL)	= 0.035 fluid ounce
1 litre (L)	= 1.76 pints
1 litre (L)	= 0.88 quart
1 litre (L)	= 0.22 gallon (Imp.)
1 litre (L)	= 0.26 gallon (U.S.)

Weight

1 gram (g)	= 0.035 ounce
1 kilogram (kg)	= 2.21 pounds
1 tonne (t)	= 1.10 short tons
1 tonne (t)	= 2205 pounds

Pressure

1 kilopascal (kPa)	= 0.15 pounds/in^2

Area

1 square centimetre (cm^2)	= 0.16 square inch
1 square metre (m^2)	= 10.77 square feet
1 square metre (m^2)	= 1.20 square yards
1 square kilometre (km^2)	= 0.39 square mile
1 hectare (ha)	= 107,636 square feet
1 hectare (ha)	= 2.5 acres

Volume (dry)

1 cubic centimetre (cm^3)	= 0.061 cubic inch
1 cubic metre (m^3)	= 1.31 cubic yards
1 cubic metre (m^3)	= 35.31 cubic feet
1000 cubic metres (m^3)	= 0.81 acre-foot
1 hectolitre (hL)	= 2.8 bushels

Speed

1 metre per second	= 3.28 feet per second
1 metre per second	= 2.24 miles per hour
1 kilometre per hour	= 0.62 mile per hour

Temperature

°F = (°C X 9/5) + 32

CONVERSION TABLES — Imperial to Metric

Length

inch	= 2.54 cm
foot	= 0.30 m
yard	= 0.91 m
mile	= 1.61 km

Area

square foot	= 0.09 m^2
square yard	= 0.84 m^2
acre	= 0.40 ha

Weight

ounce	= 28.35 g
pound	= 453.6 g
ton	= 0.91 tonne

Volume (dry)

cubic yard	=0.76 m^3
bushel	= 36.37 L

Volume (liquid)

fluid ounce (Imp.)	= 28.41 mL
pint (Imp.)	= 0.57 L
gallon (Imp.)	= 4.55 L
gallon (U.S.)	= 3.79 L

Pressure

pound per square inch	= 6.90 kPa

Temperature

°C = (°F - 32) x 5/9

ABBREVIATIONS

ai	= active ingredient
AP	= agricultural powder
cm	= centimetre
cm^2	= square centimetre
DG	= dispersible granular
DP	= dispersible powder
E	= emulsifiable
e.g.	= for example
EC	= emulsifiable concentrate
F	= flowable
g	= gram
Gr	= granules, granular
ha	= hectare
kg	= kilogram
km	= kilometre
km/h	= kilometres per hour
kPa	= kilopascal
L	= litre
m	= metre
m/s	= metres per second
m^2	= square metre
mL	= millilitre
mm	= millimetre
SC	= sprayable concentrate
SP	= soluble powder
t	= tonne
W	= wettable (powder)
WDG	= water dispersible granular
WP	= wettable powd
%	= per cent (by weight)

APPENDIX H. Spraying Application Record

Application Equipment Used:

Tank Capacity:	Nozzle Type & Pressure:	Comments:

Tractor Speed or Gear and RPM:

Calibrated Application Rate per hectare or acre:

Application Information								Environment Information		

APPENDIX H. Spraying Application Record

Application Equipment Used:

Tank Capacity:	Nozzle Type & Pressure:	Comments:

Tractor Speed or Gear and RPM:

Calibrated Application Rate per hectare or acre:

Application Information								Environment Information		

APPENDIX H. Spraying Application Record

Application Equipment Used:

Tank Capacity:	Nozzle Type & Pressure:	Comments:

Tractor Speed or Gear and RPM:

Calibrated Application Rate per hectare or acre:

Application Information								Environment Information		

APPENDIX I. HERBICIDE COMPANIES AND AGENTS

CODE	NAME	PHONE	WEB PAGE
APB	APPLIED BIOCHEMISTS INC.	1-800-558-5106	www.appliedbiochemists.com/
ARV	AGREVO CANADA INC.	1-888-283-6847	www.ca.cropscience.aventis.com
AET	AVENTIS CROPSCIENCE CANADA CO.	1-888-283-6847	www.ca.cropscience.aventis.com
ATC	ICI SURFACTANTS	1-519-756-6181	www.surfactant.com/
BAT	BARTLETT, N.M. INC.	1-905-563-8261	
BAZ	BASF CANADA INC.	1-877-371-2273	www.agsolutions.ca/
BBB	BAYER INC.	1-800-268-1331	www.bayer.ca/
CAU	CHEMINOVA CANADA	1-888-316-6260	www.cheminova.com/
BAZ	CYANAMID CROP PROTECTION	1-877-371-2273	www.agsolutions.ca/
DCS	DOW CORNING	1-800-663-4300	www.dowcorning.com/
DUQ	DUPONT CANADA INC.	1-800-667-3925	www.dupont.ca/ag/
DWE	DOW AGROSCIENCES CANADA INC.	1-800-667-3852	www.dowagro.com/canada/
EFA	ELF ATOCHEM of CANADA LTD.	1-905-827-9841	www.elf-atochem.com/newelf/homepage.cfm
GOW	GOWAN COMPANY	1-520-783-8844	www.gowanco.com
GRC	GREAT LAKES CHEMICAL CORPORATION		www.greatlakescorp.com/
GRN	GRIFFIN CORP.	1-912-242-8635	www.griffinllc.com
INT	INTERPROVINCIAL COOPERATIVE LIMITED	1-204-233-3461	
MOX	MONSANTO CANADA INC.	1-800-667-4944	www.monsanto.com/
NLC	NALCO CANADA INC.	1-905-623-8791	www.nalco.com/
NOR	NORAC CONCEPTS INC.	1-613-841-2907	www.noracconcepts.com/
NUA	NUFARM AGRICULTURE INC.	1-800-868-5444	www.nufarm.ca/
NUG	NU-GRO CORPORATION	1-519-456-2021	www.nugro.com/
PLG	PLANT PRODUCTS CO. LTD.	1-800-387-2449	www.plantprod.com/
RHQ	RHONE-POULENC CANADA INC.	1-888-283-6847	www.ca.cropscience.aventis.com
SAF	SANEX INC	1-905-602-5100	
ROH	ROHM & HAAS CANADA INC.	1-800-667-3852	www.dowagro.com/canada/
SGF	SCOTTS CANADA LTD.	1-800-668-5669	www.scottslawn.com/
STD	STANCHEM INC.	1-416-259-8231	
SYN	SYNGENTA CROP PROTECTION CANADA INC.	1-800-459-2422	www.syngenta.ca
SWC	SWIMCO CANADA INC.	1-905-873-2204	
UAG	UNITED AGRI PRODUCTS	1-800-265-4624	www.uap.ca/
UNR	UNIROYAL CHEMICAL	1-800-265-2157	www.uniroyalchemical.com/
	TOMEN AGRO INC	1-519-766-0415	www.tomenagro.ca
VAR	VAN WATERS & ROGERS LTD.	1-800-265-7671	www.vwr-ltd.com/
WBR	WILBUR-ELLIS COMPANY OF CANADA LTD.	1-306-242-4553	www.wilburellis.com/
	ONTARIO PESTICIDES ADVISORY COMMITTEE	1-416-314-9233	www.opac.gov.on.ca/
	OMAFRA WEEDS PAGE		www.gov.on.ca/OMAFRA/english/crops/insects/weeds.html
	PEST MANAGEMENT REGULATORY AGENCY		www.hc-sc.gc.ca/pmra-arla/
	WEED SCIENCE SOCIETY of AMERICA		ext.agn.uiuc.edu/wssa/

Emergency and First-Aid Procedures for Pesticide Poisoning

For a major spill, a theft or a fire involving a pesticide call the Ministry of the Environment at **1-800-268-6060.**
For pesticide poisonings and pesticide injuries call the **Poison Information Centre:**

Toronto	1-800-268-9017
Ottawa (Bilingual)	1-800-267-1373
Hearing Assistance (TTY)	1-877-750-2233

PREVENT ACCIDENTS

- **Read the label.** Follow all the precautions the label recommends. Read the First Aid section of the label BEFORE you begin to handle any pesticide.
- **Make sure that someone knows** what pesticides you are working with and where you are.
- **Keep a file of labels and product Material Safety Data Sheets (MSDS) for the pesticides you use**. Make sure everyone knows where to find this in case of an emergency.
- **Post emergency numbers near all telephones.**
- **Keep clean water, paper towels, extra gloves and clean coveralls close by** in case you spill pesticide on yourself.

If someone has been working with pesticides and you see any possible symptoms of pesticide poisoning or injury, take emergency action immediately.

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IF AN ACCIDENT OR POISONING HAPPENS

- Protect yourself from injury first.
- Stop the exposure to the pesticide. Move the victim away from the contaminated area.
- Check the 4 basic facts — identify the pesticide, the quantity, the route of entry and time of exposure.
- Call an ambulance or the Poison Information Centre.
- Start first aid. This is **not** a substitute for professional medical help.
- **Provide the label, MSDS sheet or container to emergency personnel** at the scene — or take it with you to the hospital. Do not transport pesticide containers in the passenger compartment of the vehicle.

FIRST AID

If a pesticide comes in contact with skin:

- remove all contaminated clothing; wash skin thoroughly with lots of soap and warm water
- dry skin well and cover with clean clothing or other clean material.

If pesticide comes in contact with eyes:

- hold eyelids open wash the eyes with clean running water for 15 minutes or more.

If pesticide was inhaled:

- move the victim to fresh air and loosen tight clothing
- give artificial respiration if the victim is not breathing.

Do not breathe in the exhaled air from the victim — you could also be poisoned.

If a pesticide was swallowed:

- **call the Poison Information Centre IMMEDIATELY.**

Emergency numbers are listed at the front of each Bell telephone directory.

For information, or to obtain copies of this or any other ministry publication please:

call 1-888-4-OMAFRA (1-888-466-2372) from within Ontario, (519) 826-3700 from outside the province or OMAFRA's TTY line at (519) 826-7402 for the hearing impaired, email your request to *products@omafra.gov.on.ca*, or visit OMAFRA's Web site at *www.gov.on.ca/omafra*.

A complete list of all OMAFRA products and services, and order forms, are available on the Web site. Orders can be faxed to (519) 826-3633 or mailed to Government Information Centre, OMAFRA, 1 Stone Road West, Guelph, Ontario N1G 4Y2.